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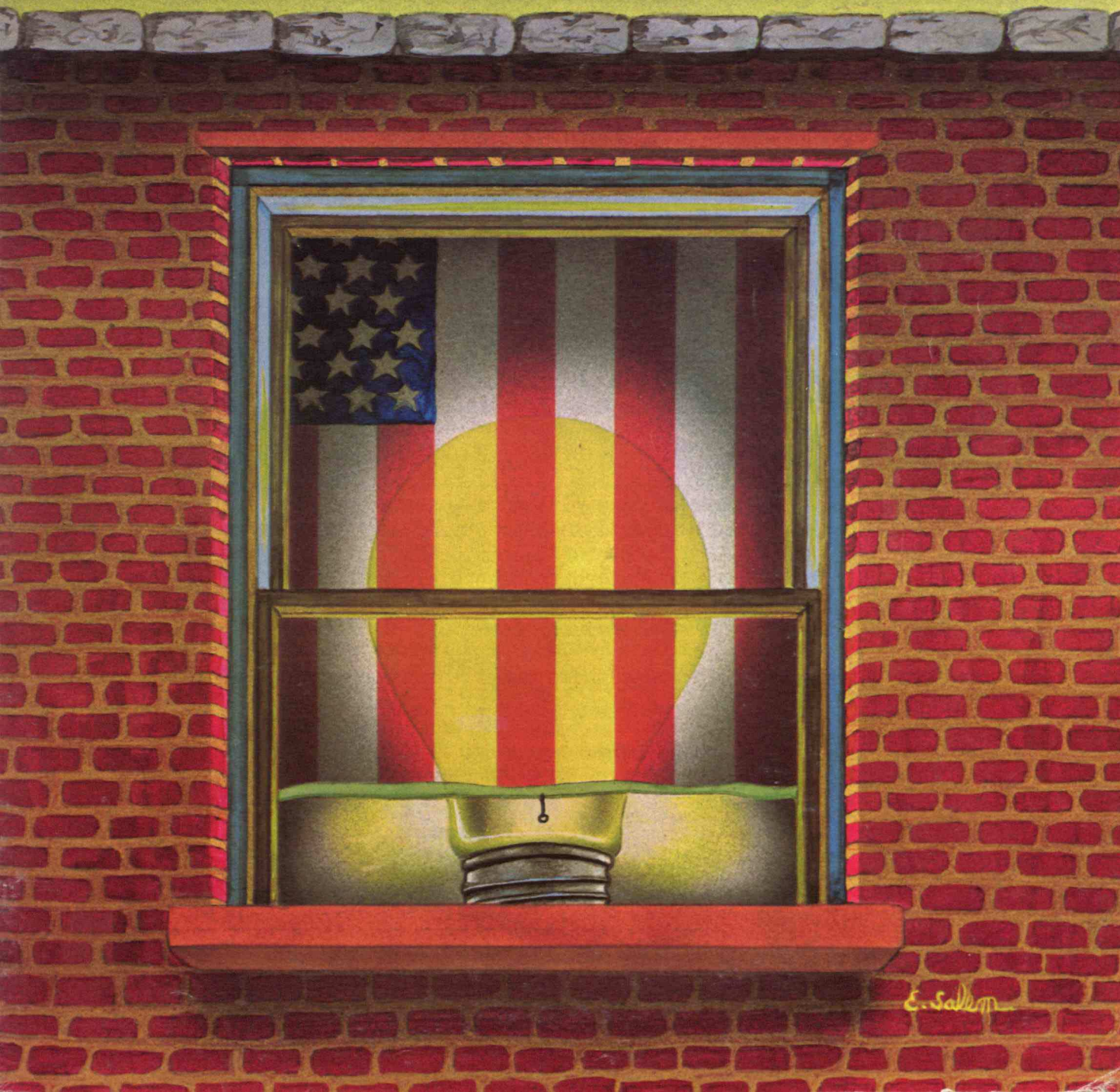
**Technologies of Illusion:
Special Effects in the Movies**

McLuhan Revisited: Understanding the New Media
Mismanagement in Nuclear Power Plants
Squeezing Oil from Tar Sands

Technology Review

Edited at the Massachusetts Institute of Technology

Walls of Secrecy, Barriers to Innovation



technology
review
Published by MIT

A new adaptive radar, using technology that could be applied in the future to many different weapon control systems, has completed feasibility tests. The radar, called FLEXAR (Flexible Adaptive Radar), uses a multimode transmitter and a programmable signal processor that are now in production, plus a new lightweight, low-cost electronically-scanned antenna. The antenna rotates once each second while the beam electronically scans up and down and back and forth. Waveforms are selected automatically to match the environment. Such flexibility enables the radar to adapt its waveform beamwidth and scan rate as needed to acquire and track targets. Hughes developed FLEXAR for the U.S. Navy.

A series of lightweight millimeter-wave parabolic dish antennas has been introduced by Hughes. The antennas, designated the 4581xH series, are made with a special aluminum and glass laminate. They are available in eight waveguide bands between 26.5 and 170 GHz and in six different sizes. The smallest, a 4-inch diameter dish, incorporates a prime focus feed. The others, in sizes of 10, 12, 18, 24, and 36 inches, use a Cassegrain feed. All are designed for low sidelobe performance. A typical weight is 7.5 pounds for the 12-inch model.

Satellite pictures are helping geologists understand major features around the world, including continental plates. Images from NASA's Landsat spacecraft, along with earthquake data, have given tectonics specialists insight into the relative motions of the Indian subcontinent and Eurasia. Scientists previously thought that one earthquake-prone crustal deformation was confined to a long, narrow zone -- the result of the Indian plate thrusting under Eurasia. Landsat images, however, revealed landforms that indicate the deformation extends over a large area quite similar to California's San Andreas fault. This interpretation also helps explain why earthquakes occur throughout Asia. The "cameras" on the Landsat spacecraft, called multispectral scanners, were built by Hughes.

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A new solid-state millimeter-wave sweep generator covers the entire W-band from 75 GHz to 110 GHz. The unit, designated Model 47726H, plugs into the Hewlett-Packard 8620C main frame or the new H-P 8350A main frame with high-resolution digital displays. Like other Hughes sweepers, it consists of a full-band sweep source, leveling loop, and a full-band sweep plug-in. An automatic feature allows the user to select the frequency spans of interest directly on the 8350A.

M.I.T. REPORTER

Radiation vs. Cancer: The Jury Stays Out

The question of human cancer risk from ionizing radiation remains unresolved. Though dose-response relationships clearly exist, "nothing absolute can be stated," says Professor Edward W. Webster of Harvard Medical School.

And in this environment, he thinks, "the public is being made overly anxious about the possible consequences of low-level ionizing radiation.

"For perspective, consider this," proposed Professor Webster in a recent lecture: "Exposure to one rem of gamma radiation to a person in his lifetime, which is much more than average, shows an incidence of cancer only one in 10,000. The incidence of cancer in cigarette smokers is 300 times larger."

A widely publicized view holds that any level of ionizing radiation is hazardous, and that the risk of cancer increases with dose. Dose includes exposure to natural radioactive isotopes and cosmic rays. The National Academy of Sciences' reports on the Biological Effects of Ionizing Radiation extrapolated from studies of cancer incidence in survivors of the devastation of Hiroshima and Nagaski to determine the effect of low levels of exposures, but since the latest BEIR report in 1980 the estimates of exposure of these Japanese to different kinds of radiation have been revised in ways that could seriously alter the conclusions of the previous studies.

Another recent study showing a direct dose-response relationship between exposure (measured from film badge readings) and cancer incidence was conducted on a group of men present at the "Smoky" atmospheric weapon test of 1957. However, not enough subjects were involved for the results to be statistically significant.

Another hypothesis proposes a threshold: ionizing radiation is damaging at high levels and damage increases with exposure, but there is a threshold exposure level below which human health is not endangered. In research at Oak Ridge National Laboratory, mice irradiated with up to 250 rads showed no significant change in lung tumor incidence. At the University of Southern California, a study had similar results with regard to bone cancer in beagles exposed to radium.

The problem with these studies is extrapolating the results to humans. The time scale correlating the life of humans and mice is uncertain, and it's been suggested that humans are more sensitive to bone cancer from radiation than dogs.

A third hypothesis suggests that low levels of ionizing radiation may be beneficial: like viruses and vaccines, radiation may trigger biological defense mechanisms. One study shows that cancer patients exposed to high levels of background radiation have lower mortality than those exposed to little or not background radiation. Likewise, in some experiments, animals irradiated at low doses have lived longer than the controls. However, studies of more subjects over a longer period of time are needed before firm conclusions can be drawn.—*Betsy Hanson, '84* □

Coping With the Hidden Curriculum

Five years ago Dr. Benson Snyder, director of M.I.T.'s Division for Study and Research in Education, concluded that M.I.T. undergraduates have to cope with two curricula: a formal one, which is defined by the requirements in the catalog and syllabi; and a hidden one which consists of each student's covert expectations in the college environment and method of meeting those expectations. In a book, *The Hidden Curriculum*, he proposed that many students deliberately elect to avoid the ambigious complexity of their surroundings and deny the presence of dissonant curricula. Such students, he says, who tie their self-esteem to one way of thinking, may miss environmental signals that would indicate impending change.

"We have found repeatedly at M.I.T.," he writes, "that when a student's sense of worth is based principally on those narrow ranges of criteria of performance that are used by the institution, two things follow. First, the student's adaptation appears to be less likely to change, even in the face of new and different environmental pressures. Second, the student appears to be less aware of the consequences of having adjusted than are his classmates."

Now Dr. Snyder is returning to interview again the students—now alumni—who were the objects of his original research. And though it is too soon to judge the consequences of college adjustment on later development (Dr. Snyder has only interviewed seven of the original 47), he believes he has seen the dangers of being too attached to one style: "A few people have not been able to change easily as their fields are redefined so that a particular mode of thought is no longer possible, and these are the ones who feel bored or depressed."

A few design their lives so that they "have no problems at all and simply lead a life which allows them to do that which they are eager to do and avoid that which doesn't fit in with it." But Dr. Snyder says that "the two people that I've interviewed so far that, as far as I can tell, are the most creative, were as freshmen much more able to decide what it was they were going to pursue; it turned out both managed this quite quickly by figuring out the hidden curriculum and buying time that they then spent in ways they wanted to. They didn't ever get caught up in trying to do everything the institute wanted them to. They saw the institute with a certain bemused irritation."

Dr. Snyder hopes ultimately to relate more accurately the character of people's learning and working environments with their ways of thinking about problems and solutions. He's already heard from a computer-maker concerned with an environment that fosters new ways of thinking. They want to avoid locking their engineers into a system dominated by financial reward if such a system hinders cognitive diversity.

Making Computers More Friendly

Only four years ago, computer industry analysts were enthusiastically predicting that personal computers would be a mass-market item by 1980. It's true that this year Americans will spend about as much on personal computers as on potato chips, and the young industry may soon overtake the pet food market.

But Nigel Searle, executive vice-president of Sinclair Research, Ltd., an English electronics company that produces what is probably the closest thing to a mass-market computer, does not believe there is yet a consumer marketplace for personal computers.

"We sell a lot of computers," says Mr. Searle—at $150, Sinclair's is the least expensive machine on the market and is selling about 40,000 per month. "But they're selling to hobbyists, to engineers, and to students. The consumer is still at the stage of asking, "What will a personal computer do for me?"'

Atari, Inc., the California-based firm that brought the world coin-operated video games, has committed itself heavily to the home computer market. Atari's Peter Rosenthall says electronic mail, banking, teleshopping, and information services should turn computers into household ap-

pliances. Unfortunately, such electronic services are still in the development stages today, and there are major stumbling blocks. "It's the chicken and egg problem," says Rosenthall, comparing home computers to the video disc industry today. "Why produce (video disc) software when there are so few video disc players out there? Why buy a video disc player when there are so few video discs? Somebody is going to have to take a giant step."

There is another view, however, of just what a personal computer is, shared by such companies as Radio Shack, Apple Computer, and IBM. These companies have directed most of their efforts to more expensive small computers for use in a business environment. They are personal in the sense that the whole machine usually sits on the user's desk, dedicated only to him; but they are too expensive for most people to justify at home. Their uses today range from word processing to business planning to accounting. Electronic mail between employees will soon become common.

Another problem—perhaps more fundamental: no matter where the personal computer is to be used, its user interface needs improvement. In the lingo of the business, computers must become more "user-friendly"—that is, easier for "ordinary people" to use. Today most systems respond to a user error with something like a beep and a cryptic "SYNTAX ERR" message—not very helpful. Personal computers must help the user along, giving him options wherever possible, not erasing two hours' work just because a wrong button was pushed.

Some new machines let the user issue many commands without even using a keyboard, by just positioning a cursor on the screen to point at the item desired. Words on the screen are often replaced by pictures, or "icons"; if you want information from a data base, you point to a drawer in a file cabinet showing on the screen. Use of the computer becomes more intuitive.

It's true that today's desk-top computer has the same power as the room-sized machine of 1960, that computers are now cheap enough to move onto office desks and soon will be priced to move into homes. But can consumers learn to use them? This is where the industry's emphasis will be for the personal computers of the 1980.—*Tom Westberg* □

Technology to Really End the Arms Race

Technology can have a very effective role in ending the arms race, says Professor David Rose of M.I.T.'s Department of Nuclear Engineering. That role is not to build more bombs to continue escalating the balance of terror, but to alleviate the root causes of war.

War, and a preoccupation with an arms race as preparaton for military conflict, presupposes the existence of enemies, "two gunmen facing each other afraid to relax in the slightest, each reaching for more guns—an endless escalation," says Professor Rose. The mutual fear that leads to war is the product of insecurity, of the failure of nations to satisfy basic human needs, Professor Rose told the Convocation on Preventing Nuclear War at M.I.T. last November 11. Technology's role should be to ameliorate the conditions that give rise to the instabilities that breed fear and frustration.

What are the strong roots that compose the foundation of real security? Energy independence, well-fed people, health care for the needy, widespread education, wise environmental management, and in general a uniform economic and social opportunity throughout the world, replies Professor Rose. Two examples of the "enlightend self-interest" necessary for a sustainable world:

□ More efficient stoves for people whose fuel comes from wood and agricultural waste to prevent tropical deforestation, denuding of agricultural land, and consequent rural collapse.

□ The genetic enginering of plant species that match rather than destroy their natural environments—including species that can capitalize on the forest canopy and its nutrients so that the fragile ecosystems of tropical forests can be preserved.

These are examples of technology for life's sake, and this is the kind of technology that could end the arms race quite simply, almost in the twinkling of an eye, says Dr. Rose.—*Rick McDermott, '82* □

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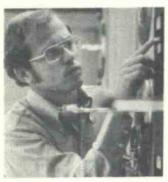

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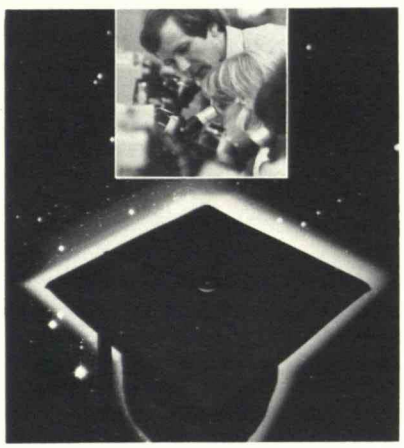
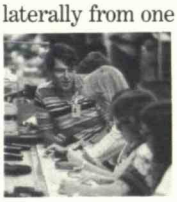


laterally from one specialty to another as well as move up. Without changing jobs.



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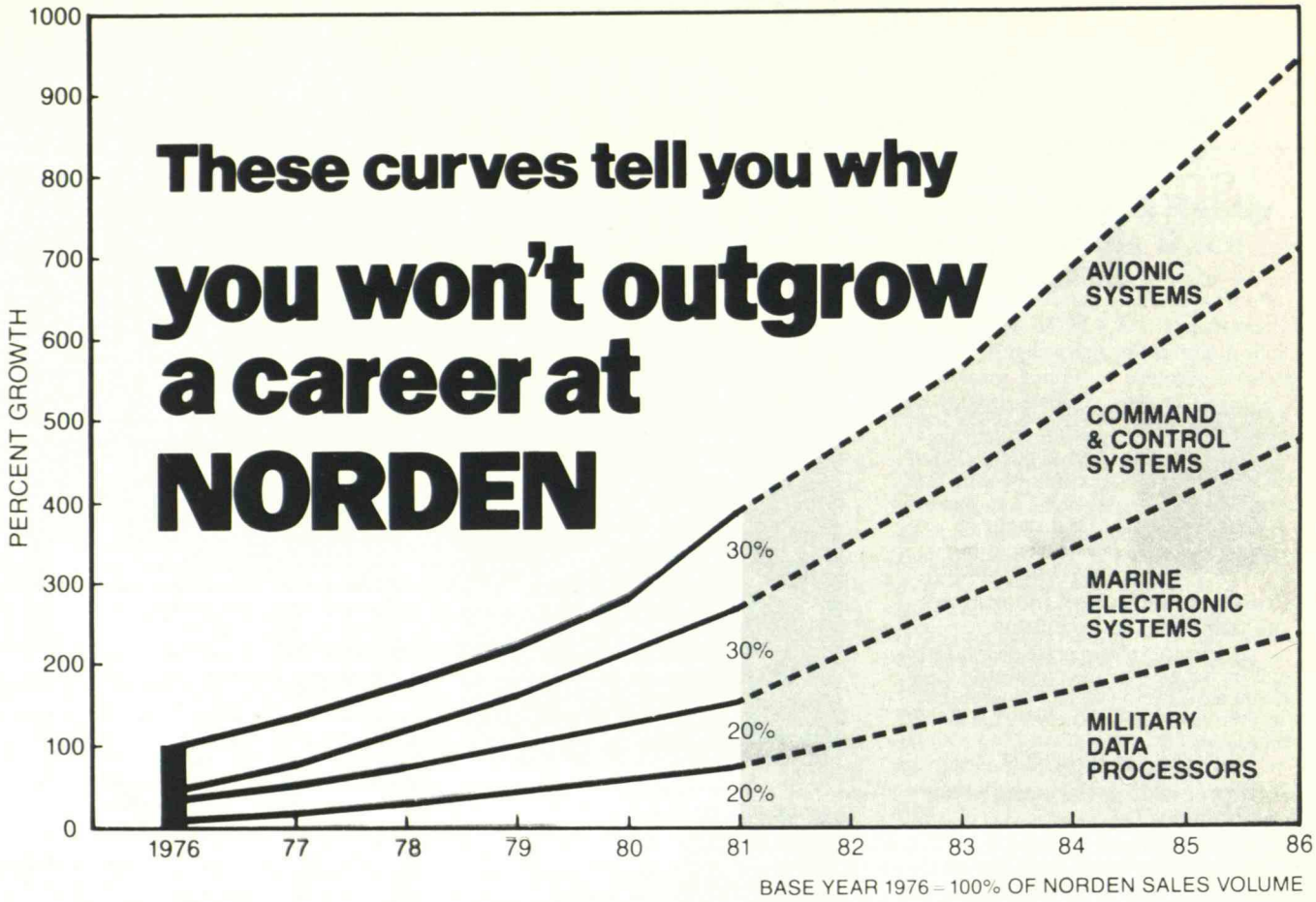

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- *ECCM Programs
- *MX missile command, control and communications data processing
- *BCS-Battery Computer System
- *MIFASS (Marine Integrated Fire and Air Support System)
- *Shipboard sensor correlation with the AN/SYS automatic detection and tracking system
- *MLRS-Multiple Launch Rocket System
- *Militarized PDP-11M minicomputers
- *Advanced artillery fire control systems
- *ASW Programs
- *Advanced Indirect Fire Systems (AIFS)

Add to the above a recent joint Army/Air Force multi-million dollar award to develop advanced millimeter radar for fighter aircraft. It all points to a totally exciting future.

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Edited at the Massachusetts Institute of Technology
Volume 85, Number 2
February/March 1982

Technology Review

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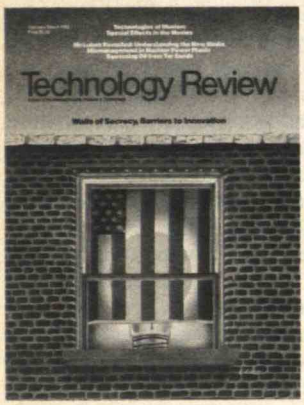

Cover painting by E. Salem Krieger
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TRENDS

COLUMNS

To bring *Technology Review* into consistency with the calendars most of us use, a new volume number (85) was assigned to the January 1982 issue; the issue in your hands is properly identified as Volume 85, Number 2. Libraries and others concerned should note that Volume 84 included only two issues—those dated October and November/December 1981. Volume 85 will include the eight issues dated in 1982.

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Technology Review (ISSN 0040-1692), Reg. U.S. Patent Office, is published eight times each year (October, November/December, January, February/March, April, May/June, July, and August/September) at the Massachusetts Institute of Technology. Two special editions are provided for graduate (pp. A1-A40) and undergraduate (pp. A1-A40 and B1-B16) alumni of M.I.T. Printed by Rumford National Graphics, Concord, N.H. Second-class postage paid at Boston, Mass. and additional mailing offices. Postmaster, send Form #3579 to M.I.T., Room 10-140, Cambridge, Mass. 02139.

Inquiries regarding editorial contents and advertising should be addressed to *Technology Review,* Room 10-140, M.I.T., Cambridge, Mass. 02139. Telephone (617) 253-8250. Unsolicited manuscripts are welcome, but no responsibility for safekeeping can be assumed.

Price: $2.50 per copy. Back issues are $4 ($5 Canada and foreign). Single back copy sales must be prepaid. Subscriptions: U.S.: one year, $18; two years, $36; three years, $54. Canada: one year, $25; two years, $50; three years, $75. Foreign: one year, $32; two years, $64; three years, $96. Send information regarding subscriptions, back issues, and reprints to Reader Service. Allow at least 6 weeks for address changes and provide both old and new address. Claims for issues lost in transit must be dated within 60 days (domestic) and 90 days (foreign) of issue.

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FIRST LINE

To Study War No More

No one person, it seems—not even the president—can singlehandedly prevent nuclear war. Yet as I sat and listened to the earnest but frustrated speakers at the Veteran's Day teach-in (November 11th) at M.I.T., and looked at the earnest but frustrated audience, and later read what speakers said at similar convocations around the country, I thought back to a conversation I once had with a distinguished expert on nuclear weapons and policy. And I was reminded that each of us wields the considerable power of personal choice.

"What's a nice guy like you doing in a field like this?" I asked him. His response included a bit of personal history (how, in exercising his technical skills, he became involved step-by-step and deeper and deeper) and a bit of modern-day nuclear fatalism (the evil is out of the box; there's no way to put it back in; therefore the best we can do is manage it well). But his answer really boiled down to this: people like him, who find such weapons repugnant, must be the ones to help deploy and control them. Otherwise, those who do *not* find them repugnant will prevail.

Such a rationalization reminds me of Red Skelton's silly-cowboy-in-the-saloon gag. "I'm gonna go shoot my mother," he says. "What?" the straight man answers in astonishment. "How can you murder your own mother?" "Well, look," says Red, "I can't let some stranger do it."

In developing nuclear weapons, in devising better ways to deliver them, in increasing their size, number, and sophistication, and in pursuing a technological oneupmanship that steadily raises the stakes while only momentarily achieving an advantage, a great many sincere and competent professionals have no doubt felt that they have contributed to world peace. Who in their right minds, after all, would attack us? No attack means no war. No war means peace. Or at least, no nuclear war—yet.

But we have alternatives. "Technology is a matter of choice, and a wide range of options is still open," Bernard Feld (professor of physics at M.I.T.) told the teach-in. "I'm not overly optimistic that either of our systems, East or West, has the ability to make the right choices, or at least to avoid the dangerous ones. But we must recognize that such choices are available."

For example, we can support organizations, from "grass-roots" to international, that pursue strategies for reducing or eliminating nuclear arsenals. But first must come some personal decisions: whether to begin, or continue, devoting one's skills to producing weapons. "That kind of work is a trap," engineer Warren Davis, former researcher on military systems and now director of High-Technology Professionals for Peace, told his M.I.T. audience. "And the best way to get out of a trap is not to get into it in the first place."—*S.J.M.* □

LETTERS

The Second Law

Regarding F. Greg Shinskey's letter on creationism (*November/December, page 3*), if Mr. Shinskey places a seed in a suitable medium and provides it with water, light, and a few inorganic salts, he will see a remarkable increase in its size and complexity. Ions will assemble into complex molecules, and these molecules will aggregate into structures totally absent from the seed. The radiant energy absorbed by the plant during growth is substantially less than the energy content of the plant, and the second law of thermodynamics has not been violated.

The second law applies to energy, not the orderliness or informational content of organisms—there is no fixed relationship between energy and informational content. Typing 100 true statements takes as much energy as typing 100 false statements or a random series of statements with no informational content. Thermodynamics places constraints on the evolution of a species and the development of an individual, but it is irrelevant to their form and direction.
John L. Fuller
York, Maine

Before Mr. Shinskey applies his thermodynamics to evolution, he should first refresh

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his understanding of the foundation of thermodynamics. The second law states that the natural tendency of matter is to assume a state of maximum disorder in a metastable equilibrium. Mr. Shinskey is applying equilibrium principles to a non-equilibrium system.
Larry Cromwell
Guilford, Conn.

Managing the Conflict

Regarding Kenneth Boulding's "Survival at Gunpoint," Steven Marcus's "Removing the Weapon," and Daniel Edson's "Two Technologies, One Atom" (*August/September*): yes, yes, yes. But so what? Three more worried cries against the wind. What would be the consequences of unilateral nuclear disarmament? It is time M.I.T. used its prestige and resources in a serious search for an answer. A symposium would be one appropriate step. Because of the issue's multidisciplinary nature, such a symposium would require experts in behavior, history, economics, politics, and defense. Both sympathizers and critics of unilateral nuclear disarmament are justifiably skeptical when rhetoric replaces reasoned inquiry.
Michael Beeler
Belmont, Mass.

Kenneth Boulding's "Survival at Gunpoint" is so slanted toward Russia that errors must be pointed out. For example, who withdrew the nuclear bombs during the Cuban crisis, and who habitually violates arms-control agreements? The French and German invasions and the hostilities between China and the West cannot be blamed for Russia's "biting Afghanistan." Russia has in the meantime chewed up Latvia, Lithuania, Poland, Czechoslovakia, and East Germany.
Carl M. Loeb, Jr.
New York, N.Y.

Professor Boulding is far too modest in describing a country's own military as being its greatest enemy. A more objective observer might award that distinction to those pseudo-scientists, economists. After all, their misguided policies led to the social chaos that brought Hitler to power, and one should not forget the benefits that Marx brought to humanity. A poll should be taken in the U.S. or Great Britain on the question of which has done more harm to society, its military or its economists.
Donald Wilkins
St. Louis, Mo.

One wishes to destroy one's enemies without competing with them, but one wishes to compete with opponents without destroying them. Mr. Marcus speaks of devastating "opponents," reminding us of the world's vulnerability to nuclear weapons. However, according to Mr. Boulding, we are more vulnerable in our use of words than we are in our use of weapons. One should not contaminate the word "opponents" with any thought of "devastating" them. If it is necessary to discuss such events, the word "enemies" should be used.
Frank Lynch
Stonington, Conn.

No one would agree to a duel under the conditions set by Mr. Boulding. The article's accompanying cartoon is apt, except that the pistols should be drawn and pointed at each person's own forehead. The threat of nuclear war broadens the "no-win" horizon.
Leonard Reid
Milwaukee, Wis.

In the Airborne Laser Lab

In "The Ultimate Battleground: Weapons in Space" (*October, page 56*), Gerald Steinberg cites the inverse square law and states that if a laser could damage a target at 1 kilometer, then "the power of the system would have to be increased by a factor of 1 million to damage targets at a range of 1,000 kilometers." However, one would not (and could not) use the same mirror with a million times the power—a larger mirror reduces beam divergence. Increasing both mirror diameter and power 100-fold would match the delivered energy per unit of area of the short-range system with one-ten-thousandth the laser power claimed necessary by the author. He further states that to point such a laser, "The entire system weighing many tons would have to be rapidly rotated." This is incorrect. Only the mirror would need to be turned.
E. Eric Drexler
Cambridge, Mass.

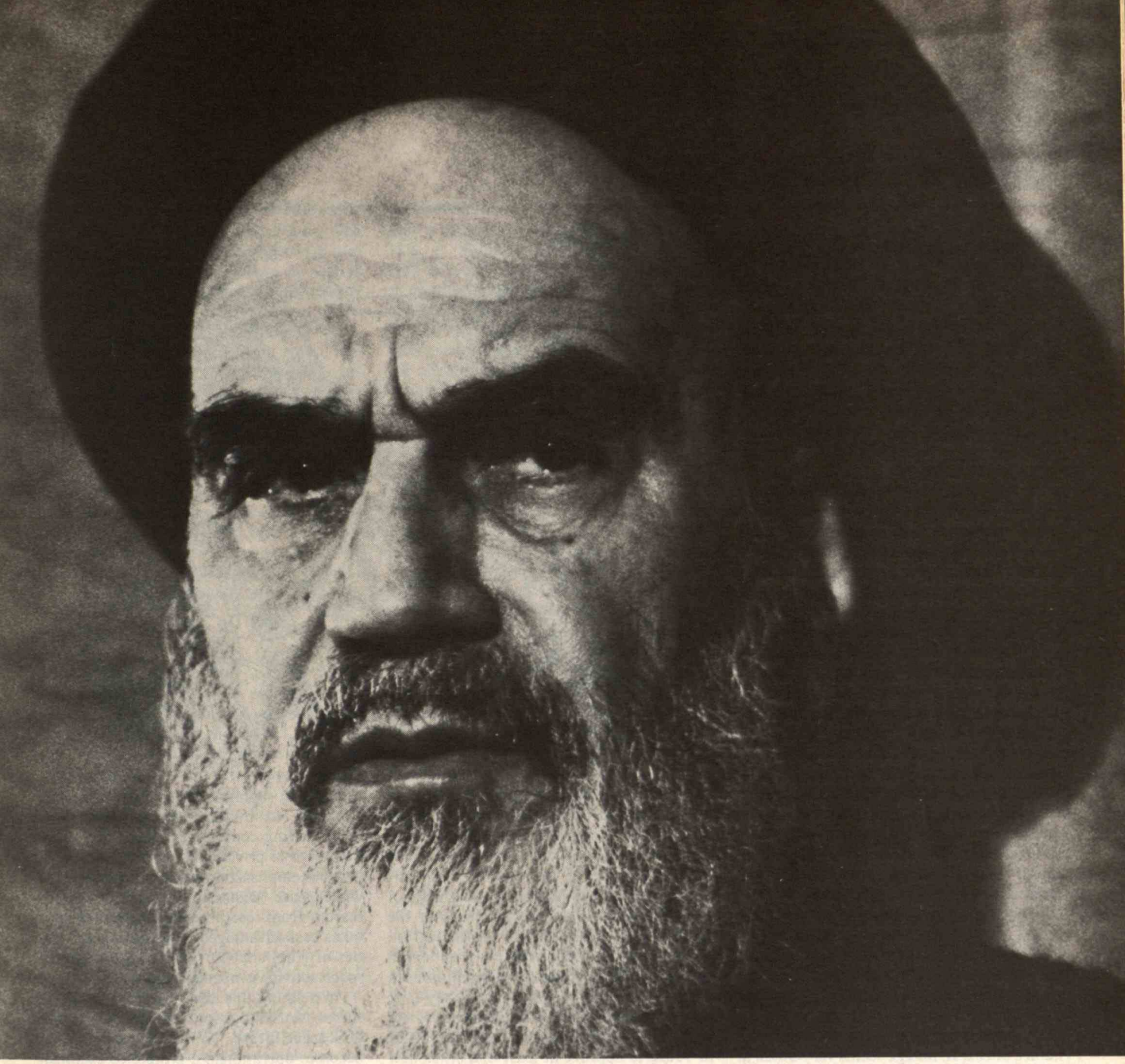
Mr. Drexler is a research affiliate at the M.I.T. Space Systems Laboratory. Mr. Steinberg responds:
Mr. Drexler is correct in noting that the ability of a laser system to damage a target depends on the combination of laser power and optics. By increasing the mirror diameter, the power output of the laser need not increase as much. However, Mr. Drexler confuses the theoretically conceivable with the practical. The optics of large mirrors, particularly those subject to various stresses in space, limit effective mirror diameter to a few meters. Also, large mirrors are not likely to be as accurate as smaller mirrors and they would only increase the vulnerability and cost of such a laser battle station. Finally, it is unclear what missions Mr. Drexler would have this system perform to justify its cost.

Growing Up in a Global Village

Like many writers he criticizes, Samuel Florman uses elegant prose to confuse technology with ideology in "Living with Technology: Trade-Offs in Paradise" (*August/September, page 24*). Mr. Florman's defense of technology in the name of maturity, rationality, and the tragic view of life is nothing but a defense of American corporate ideology. His ideas are remarkably similar to Mobil advertisements, though he uses tamer language ("freedom" instead of "deregulation" and "trade-off" instead of "risk" or "cost-benefit"). A technological determinist, Mr. Florman sees technology as leading us forward—he subscribes to the dominant American ideology and those who shape it. Writers he criticizes such as Mumford, Ellul, Roszak, and even "lionized" writers such as Robert Penn Warren and Rachel Carson see technology as leading us backward.

After constructing cardboard antitechnologists, Mr. Florman blows them down and carefully avoids demystifying his argument. Absent in his selection of writers are Orwell, Braverman, Nader, Marcuse, Galbraith, Habermas, Vonnegut, Harrington, Noble, Melman, Chandler, and Montgomery, who abhor technological determinism and are instrumental in creating what Mr. Florman calls "anticorporate immaturity."
Joseph R. Egan
Hinsdale, Ill.

I find it discouraging that Mr. Florman leaves out the *purpose* of technology. Optimists will argue for the benefits of technology and pessimists will argue about the dangers; both will be correct because technology is essentially neutral. The proper reason for technology is to release humanity from its drudgery to give people time to pursue spiritual development. What real gain is a technological society if humans become mechanized instead of expanding their awareness of the finer aspects of life? Through technology, I hope to see the evolution of sensitive and open-minded scien-
(Letters continued on p. 85)



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When most experts said the Shah would never be overthrown, one man not only warned of his possible downfall, but of its effects on the oil industry. Middle East expert Dr. Alvin Cottrell.

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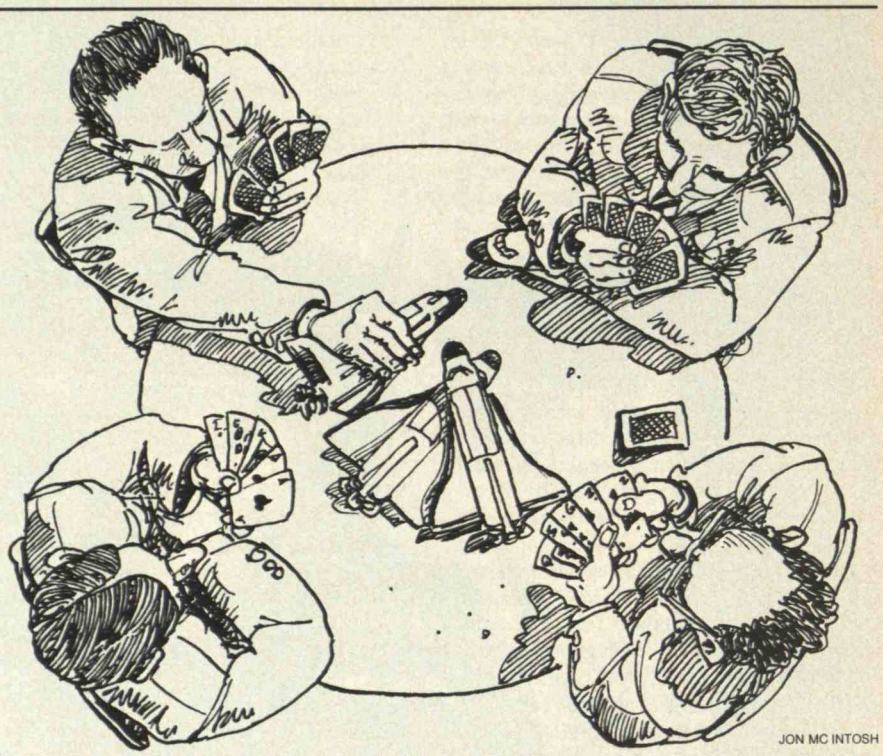
Robert Cowen

NASA's Space Shuttle Shuffle



JON MC INTOSH

ACCORDING to Charles Johnson, the space shuttle *Columbia* has never orbited earth. United Press International quotes Mr. Johnson, president of the Flat Earth Society, as saying, "It can't be done. The earth is flat." He considers orbital flight a gigantic hoax. A letter to the newspaper I serve reports that a San Francisco schoolgirl (otherwise unidentified) has an equally charming notion. When *Columbia* was launched on its second test flight November 12, she informed her teacher that two men from outer space had landed in Florida and would be staying five days.

Astronauts Joe Engle and Richard Truly, of course, have other ideas. Their five-day program was cut to 54 hours when a fuel-cell failure forced them to carry out what officials calls a "minimum mission." Yet in retrospect, they say it should be called a "maximum mission" because it accomplished virtually all its test-flight objectives. They see the mission as having impelled the shuttle development program strongly toward its goal of becoming an operational Space Transportation System (STS), as the National Aeronautics and Space Administration (NASA) calls the shuttle concept.

The maturing of that concept now challenges the United States to make up its mind as to what kind of space program it wants a decade or so in the future. How can the country make the most of the shuttle's capabilities? What should be done for the next phase of astronaut space flight? The nature of this challenge seems very much in the eye of the beholder.

Public opinion seems vague on the issue. Interest in the shuttle flights and Voyager Saturn flybys, as well as the response to Carl Sagan's fast-growing Planetary Society, suggest a reservoir of enthusiasm for space flight and exploration. But there seems to be little public demand to do something specific with the shuttle. I wonder whether many people's vision of that spacecraft may not be as whimsically misguided as those quoted above.

A Presence in Space

Planetary scientists see the STS concept as an unwelcome guest at the NASA feast whose uncurbed appetite claims an ever-larger share of an increasingly sparse menu, while the spectacularly successful planetary-exploration program slowly starves. Hence their impassioned pleas to NASA, the Congress, the White House, and anyone else who will listen to keep alive "the enterprise of the planets," as Carl Sagan and David Morrison, chairman of the Division of Planetary Sciences of the American Astronomical Association, called it in an open letter to presidential counselor Edwin Meese. "The mimimum level essential for such survival," they said, "is to complete the *Galileo* orbiter and probe for launch to Jupiter [via the shuttle] in 1985, to approve at least one other new planetary mission for launch in this decade [perhaps the postponed Venus Orbiting Imaging Radar], and to maintain the base support for science and engineering necessary to revitalize the program when a stronger economy can support it."

NASA officials, for their part, see the shuttle as their main hope for a future in space. And they want to define that future so as to retain a leading role for their agency in the face of competing claims from the military and private industry to develop practical uses for the shuttle. This concern would appear to underlie a controversial planning document circulated in November and written by NASA deputy administrator Hans M. Mark and his special assistant Milton Silveira.

Presented as a document to stimulate a policy debate, it echoes White House thinking in saying NASA should give new emphasis to military space applications while leaving commercial uses more to the initiatives of private enterprise. It also proposes deemphasizing planetary exploration while space scientists concentrate on research from earth orbit, "Because this takes best advantage of the unique properties of [the] shuttle" until a new phase of space activity is opened.

In defining this new phase, the proposal stakes NASA's claim to a key role in the U.S. space future. "While the space shuttle becomes operational, a project to establish a permanent presence in space (that is, a space station) should be initiated," it says. It adds, "This should be a major new goal of NASA, and sometime during the next two years, the president should be persuaded to issue a statement proclaiming a national commitment to that effect."

The document also urges development of a new, powerful launching rocket for unmanned missions using the technology developed for the main shuttle engines and strap-on solid rocket boosters. And, raising an issue certain to be hotly contested, the document suggests it would be wise to move shuttle mission control from Houston to Cape Canaveral, where it can be integrated with general operations. However the proposal to go for a manned space station served by the shuttle is the key element of the Mark-Silveira document.

Planetary scientists who have felt shoved aside by the shuttle project are now being asked to accommodate a second cuckoo in their nest. They will take little comfort in the vision of a new era of planetary exploration that the proposal offers. "It is probable," the document says, "that planetary exploration will be deemphasized somewhat until we have a space station that can serve as a base for the launching of a new generation of planetary-exploration spacecraft. It is apparent that the return of samples from various bodies in the solar system will be given the highest priority once that time arrives." However, as Drs. Morrison and Sagan point out, something needs to be done to keep a basic competence for planetary exploration alive in the United States in the interim.

Shuttles Ahead

Meanwhile, development of the Space Transportation System is moving briskly ahead. At this writing, Marine Colonel Jack R. Lousma and Air Force Colonel C. Gordon Fullerton were preparing to take *Columbia* on its third test flight—a seven-day mission—in mid-March. This is to be followed by a fourth test flight this year and a fifth in 1983.

At what point the STS will be declared "operational" is, as orbital test manager Donald K. Slayton has noted, a judgment call. Mr. Slayton points out that some kind of flight testing will continue at least through the tenth mission and probably longer. Yet within a couple of years, significant operational work will be completed, including in-flight research with Spacelab. This is a laboratory to be carried in the shuttle's equipment bay in which specialists can work and which is being supplied by the European Space Agency.

The second orbiter, expected to be the first operational vehicle, is now taking shape at Rockwell International's Palmdale, Calif., shuttle construction facility. This vehicle, scheduled for delivery to NASA this September, will have the projected STS life of 100 missions and accommodations for the full seven-member crew. The construction bay beside it, which has held the shuttle *Enterprise*, is empty and ready for the third of the projected four (and possibly five) orbiters to be built. The *Enterprise*, used for ground and atmospheric flight tests, now rests at Edwards Air Force base.

Also at this writing, NASA is in the process of selecting a prime contractor to take over shuttle processing operations. This is the critical turnaround phase of the STS, in which a shuttle just back from orbit is overhauled, restocked, and sent up on another job as quickly as possible. This processing now takes several months—NASA had hoped to trim this to 14 days. While that now seems unrealistic, a goal of ten missions a year per orbiter does seem attainable.

Thus, the STS seems well on its way to becoming operational, which is why NASA officials such as Mr. Mark feel some urgency to get a national debate going on both the shuttle's and NASA's future. White House officals may not be overly eager to give NASA a space-station mandate within the next few years—Victor H. Reis, assistant director for national security in the Office of Science and Technology Policy, has already thrown cold water on that. He agrees that U.S. space stations will one day be in orbit, but he would prefer that the government concentrate now on getting the most out of the shuttle. That means military uses, commercial applications (developed mostly by private industry), and science done in earth orbit, with new projects such as a space station growing out of perceived needs. Since this would tend to relegate NASA to the role of handmaiden to industry and the Department of Defense, the debate over the space station may be lively.

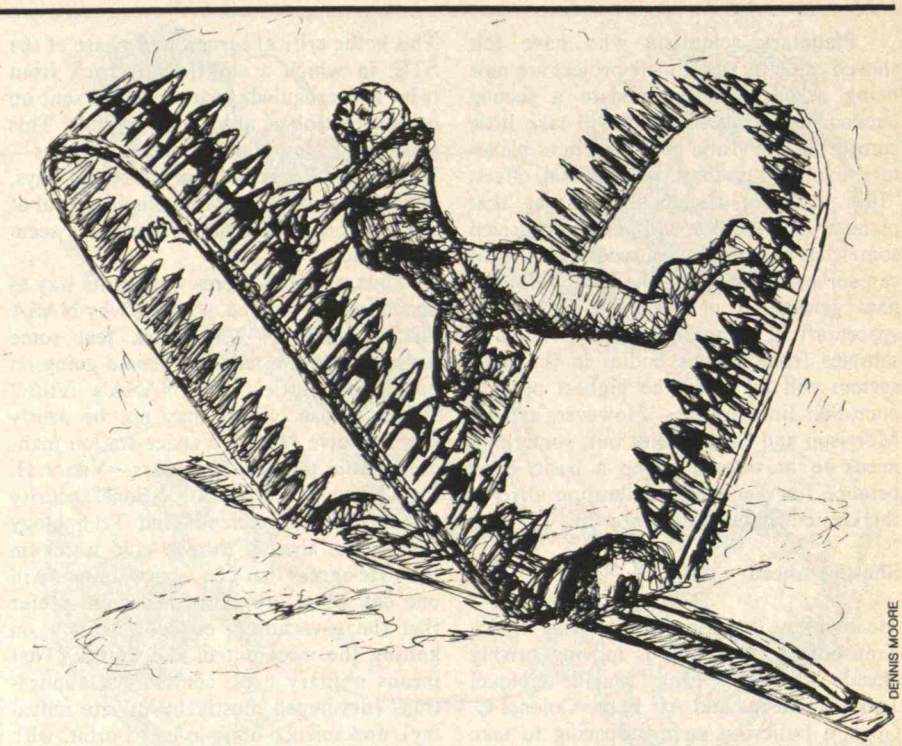
Whatever view prevails, exploration of the solar system in this decade is likely to lose out; pleading for more at the present NASA table is likely to be futile. What is needed is some imaginative new planning by planetary scientists, ideas that can become part of the debate over the space program's future. The concept of using relatively inexpensive probes, now being studied by NASA's Solar System Exploration Committee, has merit. While these would be more modest and return fewer data than the U.S. space-science community has been accustomed to, such probes could keep solar-system exploration going.

Some planetary scientists appear to believe there is enough public interest to support a major new mission or two, but I think they are dreaming. They should wake up and get into the space debate more productively. □

Robert C. Cowen is science editor of the Christian Science Monitor *and former president of the National Association of Science Writers. He holds S.B. and S.M. degrees in meteorology from M.I.T.*

Kenneth Boulding

Appropriate Strength



DENNIS MOORE

I have heard that one reason the Japanese are so successful in ritualizing and managing their internal conflicts is that the Japanese language is so delightfully ambiguous that nobody is ever quite sure what has been agreed to. When everybody nods approval, one has an uneasy suspicion that each person is approving of something different. The English language shares with Japanese this capacity for ambiguity. I have heard that at the United Nations an agreement is sometimes reached in English, only to have the French translator say, "Do you mean this or that?" The whole agreement then falls apart, French being a language with too little ambiguity.

Ambiguity, indeed, may be a virtue in dealing with complex situations. I used to tell my students that if they were clear about the economic system, it was a sign they were being unrealistic. It is a great mistake to have clear ideas about aspects of reality that are in fact a muddle, as a good many aspects of reality are.

Two words in the English language that are particularly prone to produce agreement through ambiguity are "appropriate" and "strength." Nobody can come out against things that are appropriate, for nobody will ever confess that what they do, say, or think is inappropriate. Everybody agrees, for instance, that technology should be appropriate. But the agreement is empty unless we have some idea about what is appropriate in a particular situation. In one case this may well be the substitution of long-handled for short-handled hoes. In another, it may be rural electrification or "high tech."

Strong Is as Strong Does

"Strong" is a word just as ambiguous as "appropriate," and again, this is probably why there is such wide agreement that being strong is good, for nobody wants to be weak any more than they want to be inappropriate. However, strength is only a potential for something. The critical question is: potential for what? What are we strong for?

The word "strong" calls up images of body builders, boxers, or football players, but even muscular strength is only part of the potential of the human body. Body builders often die young; fragile old ladies live to be 100. Athletes soon pass their prime and are forgotten; philosophers often continue to produce into old age, and their work may be remembered for thousands of years. If we have wrong—that is, inappropriate—concepts of strength, the effort to become strong will actually make us weaker and less able to survive, less able to do the things that we really want to do.

If we do not understand the systems we are dealing with, we are unlikely to find the appropriate next step, and we are unlikely to do the things that lead to appropriate strength. It is inappropriate to resolve conflicts by getting into fights if there are better and cheaper ways of resolving the situation, as the air-traffic controllers have discovered to their great cost and the cost of all us. It was inappropriate for Austria-Hungary to try to defend itself by getting into World War I, which destroyed it.

The strength of a complex system is important, not the strength of the parties within it, except when their strength is appropriate to the preservation of the system. Furthermore, the quality of strength is of overwhelming importance. Strength designed to damage others intensifies the threat and easily leads to a systems breakdown, which damages the threatener. Strength used to benefit others as well as oneself—often the case in exchange and economic systems—creates positive-sum systems that increase everybody's strength.

National Defense: Our Undoing

My readers will not be slow to catch on to the implications of what I am saying. My conclusion is that unilateral national defense organizations (a very appropriate acronym for which is UNDOs) constitute an interactive world system, the strength of which constitutes peace but which breaks down into war when it is not strong enough to withstand the strain. This system is based on threat, frequently mutual threat (deterrence), and the credibility of these threats erodes unless they are occasionally carried out. Until the age of nuclear weapons, this system was costly but not fatal. Now, if it persists, it has the certainty of being fatal. Strengthening unilateral national defense organizations weakens the nation and society they are supposed to defend. It creates an illusion of strength—inappropriate strength—that is actually weakness.

The only path to national security is the abolition of national defense as a world system. I am under no illusions that this is easy or costless. I am anxious to preserve national states, for they are among the principal preservers of the variety necessary if human cultural evolution is to continue. I would rather have many nations in stable peace than one world that could easily become tyrannical. But if we try to pre-

(Continued on p. 18)

The Best Social Program

Verily, America faces a daunting range of social woes. They demand solutions. Many of our citizens are cut off from opportunity. They need help.

How best can the problems be met, the people helped? For too long, we as a nation have sought answers through an elephantine, hyperactive government bent on redistributing resources by taking from the haves in taxes and giving to the have-nots through a welter of social programs.

But that hasn't worked. The problems have festered and spread even as taxes and spending and governmental involvement have ballooned, oppressing all with crunching taxation and inflation.

It hasn't worked, for one thing, because we've become so preoccupied with slicing up the economic pie that we've neglected the essential task of making the pie bigger. We've become split up into a nation of factions, with each segment and interest group—business included—scratching and scrambling for its share. When the pie shrinks or stagnates, each group fights all the more desperately for a share of what's left. Consensus gives way to confrontation in our political life.

We've become more engrossed in carving out a larger slice of someone else's wealth than in producing more wealth ourselves. In the process we've lost sight of what forged the American economic marvel in the first place: an expanding private enterprise economy functioning in a free society to increase the wealth and living standards of those who are willing to get out and work for what they want.

"A rising tide lifts all boats"—that's how President Kennedy put it a couple of decades ago. His message long went unheeded by our national leaders. Now it's getting through. Emphasis anew is centered on the need to create, compete, produce, earn—and grow. Once again priority is being given to fostering the initiative and enterprise that power sound economic growth of the kind that will bring opportunity and advancement to all... lifting all boats.

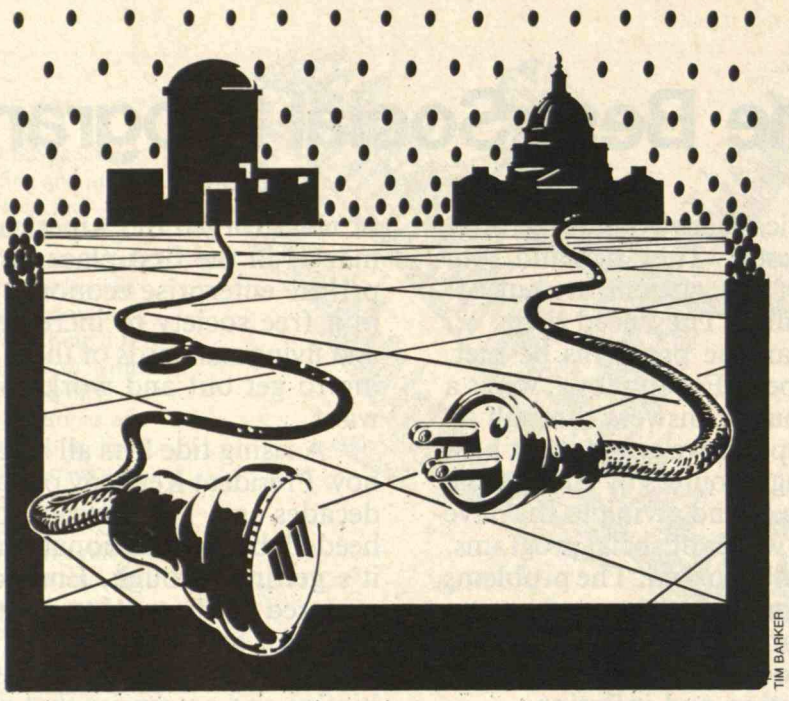
What is overlooked too often is that those in greatest need stand to gain the most from national economic progress. For they are the farthest behind, and they have the farthest to rise.

There'll always be a need, of course, for publicly funded social programs and for government to step in and help those trapped on the bottom rungs. The wherewithal for the public sector to do all we expect of it must come from the private sector. The best social program of all is a strong, growing, productive economy.

UNITED TECHNOLOGIES

Full Ahead for Nuclear Power?

by Victor Gilinsky


TIM BARKER

On its face, the political climate for nuclear power could hardly be better. President Reagan entered office on a strong pronuclear platform, prompting the head of the Atomic Industrial Forum to describe his mood as somewhere between "euphoria and ecstasy." In October 1981, the administration made public its official position on the future of nuclear power, giving the industry the endorsement it had sought in vain from the previous administration.

The new policy directs the Department of Energy (DOE) to coordinate federal efforts to streamline the nuclear licensing process, calls for completion of the Clinch River breeder reactor, lifts the ban on commercial reprocessing of spent nuclear fuel, and instructs DOE to swiftly deploy a system for storage and disposal of high-level nuclear wastes. According to Energy Secretary James B. Edwards, the policy "will allow native American creativity, which has made us the world's leader in technology, to flower again."

My own view is that there is little behind the rhetoric. It is difficult to see how the administration's package will do much to reverse the current decline of nuclear power. Some useful adjustments can be made in the regulatory setup, but it is an illusion to think these can be the source of a nuclear revival.

The only stage at which any licensing holdup is likely to occur is the beginning, when utilities seek construction permits for new plants. But "streamlining" these initial licensing procedures will be no more than an academic exercise if there are no new plants. Despite the ritual pronouncements of utility executives, orders for new plants are held back less by regulators than by the market's "invisible hand."

And despite vocal complaints, no plant ready to go into operation is being held up by Nuclear Regulatory Commission (NRC) hearings. It turns out that plants thought to have been held up by licensing procedures have been stalled instead by equipment or other safety problems.

Decisions to abandon new plant construction are not governed by the delays associated with the regulatory process, and every utility company knows this. Rather, these decisions have been impelled by the forces of energy supply and demand. Construction problems, in some cases new safety requirements, and financing difficulties have driven up costs while the need for these plants has been diminishing steadily over the past four years (growth in electrical demand declined to 1.7 percent last year). Eleven plants have been canceled since the presidential election.

Nuclear Energy Recount

In view of these changes, most nuclear power projections, official and unofficial, are outdated. If we count plants to which there is now a firm and reasonable commitment, we arrive at a nuclear capacity of about 115,000 to 120,000 megawatts sometime in the 1990s. And no new construction permit applications are on the horizon.

Currently, 72 plants are licensed for commercial operation, representing electric generating capacity of about 55,000 megawatts. There also are 77 large plants (with a capacity of roughly 1,000 megawatts each) in various stages of completion, some almost finished, others hardly begun. I expect that at least 20 of the plants under construction will be canceled, and only 1 or 2 of the 10 plants under construction-permit review have much chance to see the light of day (for economic reasons). What this adds up to is no more than 50-odd plants (about 60,000 megawatts) headed for completion.

I am not saying that things could not improve for nuclear power, or that more plants might not be built. The economy might pick up, electrical demand may climb, steps to increase efficiency may be less effective than projected, and (who knows?) someone might produce an electric car that catches on. But it is difficult to see how these things can happen in the time period business must consider. My projections could as well be too high as too low—if, for example, electrical demand growth is further depressed by higher prices. And what lies beyond this decade is difficult to predict.

One unfortunate characteristic of planning for nuclear power has been that almost everyone tries to nail down the distant future at the expense of protecting what's on hand today. This afflicts the adminstration's policy on nuclear power, which seems to say that if the regulators will start being more efficient, and if the breeder is successfully demonstrated, and if commercial fuel reprocessing is allowed, the future of nuclear energy will be assured. Let's take a closer look at this proposition.

Streamlining Licensing

The president's designation of DOE to coordinate federal streamlining of power-plant licensing overlooks several problems. DOE has very little experience in this area. (It is also one of NRC's prospective licensees and thus has a potential conflict of interest in "coordinating" the NRC's activities.)

Repeated insistence that the licensing process is holding up plants only distracts attention from real problems. Plants now in the pipeline may sometimes be burdened by regulators, but they are seriously plagued by a variety of construction delays and mistakes, labor problems, and manage-

ment failings, to say nothing of a severe tightening of the money-market funds available for financing. Plants *have* had to delay operation to comply with NRC safety requirements, but to disagree with that necessity is to deny the need for safety at NRC's standard. Not many people will find such an argument persuasive after the accident at Three Mile Island (TMI).

The Reagan policy statement does not acknowledge the root of many difficulties experienced by the nuclear industry. These can be traced to the time when the government handed an advanced technology over to utilities accustomed to operating older technologies. Many of these utilities underestimated the inherent dangers and technical problems of nuclear power. Some did not have managerial competence to handle projects as sophisticated as nuclear plants. Some simply lost control, both of quality and costs, and have had to be brought up short by the NRC or their bankers. Even some of those who did a good job are now finding their construction plans upended by economic problems.

Breeding and Reprocessing

The commitment to the Clinch River breeder reactor is a distraction from these problems. Not only will it consume money in large quantities, but it will also eat up the government's bureaucratic energies to little effect. To use an economist's term, the opportunity cost is very high. I feel that even though the Clinch River breeder is currently funded, it will not be built. The country is just not in a mood to fund projects that do not make economic sense. And this one doesn't make sense now because uranium is plentiful and the number of reactors expected to use it is diminishing.

There is also a bit of flummery in the reprocessing decision, for while the administration is supporting commercial reprocessing of spent fuel, it is also declining to pick up the check. Officials can't help but know this means there will be no commercial reprocessing. Apparently that's the way Allied Chemical Co. sees it, too. A few days after the policy announcement, Allied revealed plans to write off its half-share in the Barnwell commercial reprocessing plant, the only one possibly expected to operate in this decade. An Allied official said that the government would have to guarantee the market or "no one is going to go into this business." (The Barnwell plant is also unable to process its waste fluids into solids suitable for underground disposal, a capability likely to cost as much as the reprocessing portion of the plant.) So much for commercial reprocessing.

Swift Action on Wastes?

Unfortunately, that is not the end of it because the administration has entangled spent-fuel reprocessing with nuclear waste disposal. The picture from recent congressional testimony is that the administration views reprocessing as the key to dealing with the back end of the fuel cycle. The government makes a careful distinction between spent fuel and high-level wastes generated by a reprocessing plant—only the high-level waste is headed for the underground repository. "It is our hope," said DOE Assistant Secretary Brewer, "that we will not dispose of much spent fuel, that we will reprocess the spent fuel and recover its fuel values, and convert the waste into solid form for disposal."

The administration has presented us with a conundrum: DOE says reprocessing of spent fuel is essential before the ultimate disposal of nuclear wastes. At the same time the Office of Management and Budget declines to provide a subsidy for private reprocessing, without which the private sector says reprocessing is not feasible. In view of this, how can DOE proceed swiftly to dispose of high-level waste?

Whatever the explanation for this contradiction, the new reprocessing policy is bound to undermine the waste-disposal program. This will increase uncertainty about waste disposal and further undermine public confidence in nuclear power, the opposite of what the administration says it wants.

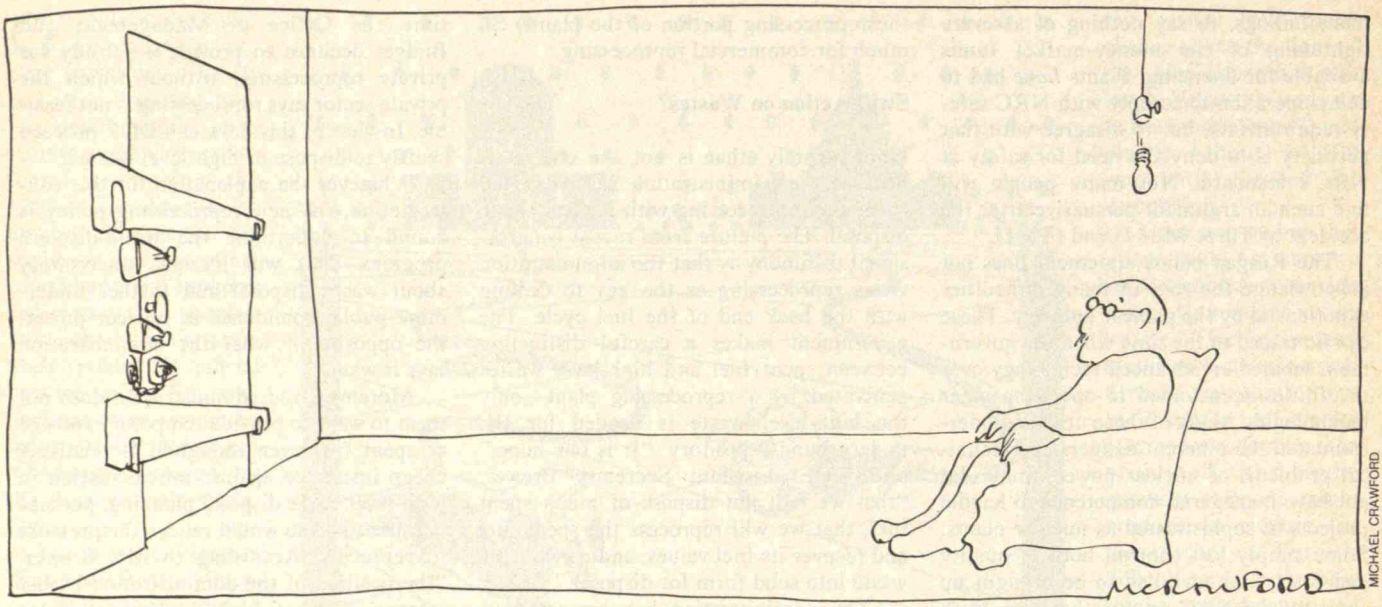
Moreover, the administration does not seem to want to provide temporary *storage* of spent fuel even though it is relatively cheap insurance against miscalculation in high-level waste disposal planning, perhaps because to do so would relieve the pressure to reprocess. According to Mr. Brewer, "the position of the administration is that storage of spent fuel is a private-sector responsibility."

There is not, in fact, a great deal the

(Continued on p. 18)

Risk Analysis and the Congressman-Engineer

by Samuel C. Florman



***Regulatory action shall not be undertaken unless the potential benefits to society outweigh the potential costs.*—President Reagan shortly after taking office.**

READING the president's statement, I could not help but think what an exhilarating moment this must be for proponents of risk analysis. And what a particularly exciting time it must be for Donald Ritter, the engineer-Congressman who has sponsored legislation that would require government regulators to be guided by standardized, stringently scientific analyses of comparative risks. The era of confused emotionalism is over, I thought. We are entering a new Age of Reason.

I first learned about this crusade in an *Engineering Education News* article with the eye-catching title "Donald Ritter: The Only Engineer in the United States Congress." I had always known there were not many engineers in politics, but never imagined that out of 535 members of Congress there was only one. As it turns out, there are one or two others who qualify according to educational background—such as Rep. David Emery, an electronics engineer from Maine. But in essence, if not in literal fact, Ritter *is* unique.

A Republican from Pennsylvania's 15th District, he campaigned as an avowed engineering professional and came to Washington in 1979 bearing high a banner of technical proficiency. Soon I was reading about him in numerous professional periodicals, all noting with satisfaction his determination to apply engineering methods to the legislative engine. "Rational thinking is not always in tune with the bureaucratic political process," he was quoted as telling the Council of Scientific Society Presidents, "and the absence of this kind of thinking will continue to lead us downhill."

Cheering for Engineers

I follow the careers of eminent engineers the way I follow the fortunes of American athletes in the Olympics—with a mixture of pride and anxiety. We are all partisans at heart, whether rooting for our national team, arguing hometown merits, or wearing the old school tie, and loyalty to one's profession is a manifestation of this elemental human trait. I am an engineer, so I want engineers to do well.

There is another reason, however, to want engineers to prosper in public life: engineering is the embodiment of rationality. In a world seemingly filled with mendacity and foolish whim, clear thinking needs to be nurtured. No one feels this more keenly than members of the engineering profession, who constantly exhort each other to become active in the public arena. Thus, at a recent seminar on "The Role of the Engineering Community in the Public Decision-Making Process," a speaker lamented that although 25 percent of the members of the first Continental Congress were educated in science and technology, hardly any are today despite the fact that 40 percent of the bills in Congress have significant technical content. Small wonder that Rep. Ritter—who holds a doctorate in metallurgy from M.I.T., taught for 10 years at Lehigh University, and speaks boldly in the language of scientific rationality—should have captured the fancy of the engineering profession as he embarked on his career in government.

At a time when the purported excesses of government regulation are the subject of intense controversy, Rep. Ritter's proposal to subject regulations to scientific scrutiny quickly gained a large and attentive audience. The hearing on his bill—which calls upon the Office of Science and Technology Policy of the executive branch to "apply and promote" risk analysis in all regulatory agencies—drew overflow crowds for two days in May 1980. "Mr. Speaker," intoned Rep. Ritter in calling attention to the bill on the House floor, "comparison of risks is a way for regulatory agencies to do a better job of protecting the public—by targeting their limited resources on the most serious threats to health and safety instead of regulating 'blindly.' Comparison of risks brings government regulation into the 1980s."

Hear, hear!

Yet the more I thought about this wondrous new analytic approach, the more uneasy I became. It all seemed too pat. If there were truly reliable methods of analyzing and comparing risks, why on earth would regulatory agencies not be using them? And if these methods were being resisted, perhaps they were not as wonderful as advertised. I decided to learn more about risk analysis by finding out what transpired at the hearing on Mr. Ritter's bill.

The Story Unfolds

The hearing took place before the Subcommittee on Science, Research, and Technology of the House Committee on Science and Technology. The transcript reads like a contemporary novel, with dramatic twists, memorable scenes, and an ambiguous ending that resonates in the imagination.

Things began promisingly enough as several colleagues showed up to laud this new initiative. Rep. William C. Wampler of Virginia hoped that risk analysis would eliminate the "confusion and chaos" of current regulatory practice, particularly the unwarranted curbing of pesticides and food preservatives. Mike McCormack, then congressman from Washington, warned that quibbling over the negligible risks of nuclear power was "keeping this country from moving forward." Other representatives deplored the Food and Drug Administration's conservative approach in approving new drugs and its attempt to ban saccharin, the Environmental Protection Agency's caution concerning diesel-fuel emissions, and the Nuclear Regulatory Commission's timidity about releasing krypton gas during cleanup of Three Mile Island. Only Tom Harkin of Iowa, apologizing for being "a thorn among the roses," counseled caution. Citing the examples of thalidomide and Agent Orange, he suggested that if we make mistakes it is best to err on the side of safety.

Next came the invited technical experts. James Vaupel of Duke University sought to dramatize the benefits of risk analysis by evaluating the often-heard admonition against eating too many eggs. Although eggs are high in cholesterol and may contribute to atherosclerosis in some individuals, the risk of eating them has, according to Dr. Vaupel, been greatly overstated. By cutting in half the average American's consumption of eggs (five per week), an estimated 5,000 lives might be saved each year.

Although this sounds worth doing, when stated in different terms it appears practically insignificant. For example, halving weekly consumption will extend the average American's life expectancy by only 10 days. Thus, each egg consumed, when viewed over a 73-year average lifespan, might reduce life expectancy by about a minute; further calculation shows that eating six eggs weekly represents a one-in-a-million chance of causing a death each year, qualifying as a "microrisk." Other microrisks, for the sake of comparison, are smoking 1.4 cigarettes, living two days in the air pollution of New York or Boston, traveling 10 miles by bicycle or 300 miles by car, drinking Miami's water for one year, eating 40 tablespoons of peanut butter (owing to liver cancer caused by aflatoxin B). These are the sorts of comparisons that Rep. Ritter would require regulatory agencies to consider and put before the public.

Although Dr. Vaupel's aim was to support the bill—and incidentally to ridicule what he called "the Humpty-Dumpty assault on eggs"—the effect on me was to arouse longstanding misgivings about the manipulation of statistics in public discourse.

The next witness was Walter Albers of the General Motors Research Laboratories, who considered the comparative cost-effectiveness of several life-extending programs. A coronary ambulance system, he noted, can save lives at a cost of $192 per person-year of longevity, and for highway rescue helicopters the cost is $4,180. In contrast, the cost of installing four headrests in a car is $500,000 per person-year of longevity, and achieving EPA's carbon-monoxide emission standard would cost $27.5 million. Although Dr. Albers' presentation was undeniably illuminating, under the drapery of his figures the self-serving arguments of General Motors were revealed with a clarity that was almost embarrassing.

The Plot Thickens

Up to this point, Rep. Ritter had heard exactly what he wanted. However, the next witness, Howard Raiffa of Harvard University, head of the National Academy of Sciences Study Group on Risk and Decision Making, made explicit what the previous two speakers had demonstrated in spite of themselves—that risk analysis is not the panacea its boosters claim. He stressed the complexity of the decision-making process and noted some important factors that do not lend themselves to numerical resolution: how is one to calculate public discontent and personal happiness? Equity and justice? Individual freedom and personal autonomy? How is one to measure efficiency versus equity? Short-term versus long-run considerations? People's interest versus nature's? American interests versus the world's? Dr. Raiffa also raised a point that calls into question the value of the entire risk-analysis enterprise: "The probabilities of various adverse health or environmental effects are often so uncertain that experts disagree by orders of magnitude."

This was emphasized by David D. Doniger of the National Resources Defense Council, who observed that studies by the Occupational Safety and Health Administration (OSHA) on the carcinogenic effects of vinyl chloride have shown a range of disagreement of more than a millionfold. Cost estimates are also subject to large differences of opinion. For example, the estimated cost of complying with a new standard for coke-oven emissions was 10 times higher when prepared by industry experts than when calculated by government specialists.

Unfortunately, such uncertainties are usually highest in matters of greatest concern, such as PCBs, asbestos, radiation, and chlorinated hydrocarbons in drinking water. This was underscored by Nicholas A. Ashford of M.I.T.'s Center for Policy Alternatives: "The easy cases, which exemplify the benefits of simple risk assessment, aren't the ones that give us problems. Those aren't the cases that need working on."

Then the hearing shifted from technical matters to issues of political and social philosophy. Speakers from the Monsanto Co. and the National Association of Manufacturers commended Rep. Ritter and supported his initiatives. In response, a representative from the United Steel Workers, expressing some impatience with being told "that we are safer in a steel mill than we are in our own bathtub," characterized the proposed law as "a barrier against further expressions of responsibility."

Finally Rep. Ritter, like a host whose party is being spoiled by unruly guests, expressed consternation: "I think we are seeing here somewhat of a polarization. I think people have come into this room with certain values locked onto certain interests. I would hope . . . that we could somehow get away from that." But this hope was not to be realized, as the hearing increasingly deteriorated into bickering between industry spokespeople on the one hand and representatives of labor and public interest groups on the other.

Changes in Chapter Two

The next day's program, featuring government agency spokespeople, was to see Rep. Ritter's discomfort grow apace. First, an official from the Office of Science and Technology Policy stressed that his organization wanted no part of the responsibility delegated to it by the new bill, and indeed

(Continued on p. 86)

The Other Side of the Mountain

Mountains and Man
Larry W. Price
Berkeley: University of California Press, 1981, 506 pp.

Reviewed by Sara Jane Neustadtl

ILLUSTRATIONS: KATHERINE MAHONEY

For the last ten years a group of people in the village of Townsville, Australia, has been lugging buckets of gravel to the top of nearby Castle Hill, elevation 349½ meters. Australia has decreed that to be a mountain, an outcrop must stand at least 350 meters high. The townspeople are pursuing that last half-meter—trying to upgrade their hill into a legally sanctioned mountain.

A British climber in the Himalayas asked his guide the name of the mountains through which he was traveling. As these peaks were a mere 11,500 feet high, his guide informed him that they weren't mountains at all, just foothills.

Larry Price has been similarly arbitrary. He has decided that a mountain must poke out at least 1,000 feet and be steep-sided to boot. Clearly, the definition of mountain depends on your point of view.

It takes Price 5 pages to decide what a mountain is; it takes him another 500 to explain what goes on in, among, and around them. The result is a landmark effort. *Mountains and Man* is a well-written and thoroughly researched analysis of mountains and their ecological processes. Price has no models from which to draw: his is the first and only book of its kind.

Much of Price's documentation, and many of his excellent and clearly drawn illustrations, were gathered from journals. He discovered sources in such diverse fields as geology, anthropology, botany, biology, hydrology, physiology, meteorology, agronomy, forestry, and archeology. His 50-page bibliography is also an impressive achievement, and what's better, each of its entries is cited, explained, and put into context. The reader is guided through theoretical controversy on the most esoteric matters—it's almost like eavesdropping.

Price covers mountain origins, climate, snows, landforms, soils, vegetation, and wildlife. His best chapter is on his own field of geomorphic processes—the study of erosion. It would be nice if this chapter could be reprinted the size of a trail guide and carried along on mountain hikes for the pleasant shocks of recognition it affords. Aha! the hiker would say, I always wondered how that worked.

Price makes observations of hair-splitting detail. An example: a rock chiseled in two by frost wedging is a common sight in the mountains. It can be the victim of the lateral growth of ice crystals rather than the penetration of frost deeper and deeper into a crack. The rocks that appear fresh from the earth in a mountain meadow after spring thaw have been both pulled and pushed from the earth by frost. A curving base of a tree trunk on a mountain slope indicates that the soil is creeping downhill. All these phenomena, Price points out, occur more often on northeast-facing slopes, where frost processes are most active in this hemisphere.

Price interprets events that take hundreds or thousands of years to complete. Mountain travelers—who see only one frame of stop-action in geologic time—will, with Price's help, find themselves surrounded by scores of movements in rock, soil, water, and snow where first they perceived only stillness. So the book, presented as a textbook, will captivate the naturalist and hiker as well as the student. But its most important function is as an introductory text for the increasing number of people who are choosing to study mountains as discrete systems.

Public consciousness has only recently begun to focus on the science of mountain ecology, its practitioners are cubbyholed in fields as unrelated as pedology (the study of soil) and ethnography. Nonetheless, it's sure to gain in popularity. Like the oceans, the mountains are increasingly affected by human activity and like ocean processes, natural mountain processes are essential to people everywhere.

A Rock Unturned

The examination of the ability of human beings to alter mountain environments is Price's weak spot, and in this sense, *Mountains and Man* is a misnomer. While Price combs the tundra for the most minute signs of life and describes them in microscopic detail, he takes too broad a swipe at the human impacts on mountain environments and misses much. For example, he writes that "the economy of the entire Western United States is dependent upon meltwater from the mountains . . . With increasing population, assessment, management, and improvement of this resource has become a major enterprise." The statement, while undeniable, is meaningless without details.

Mountain streams have the reputation of being pure and clean, but this is a myth largely fostered by breweries. The encroachment of human activity into mountain heights is leading to trouble for communities both in the mountains and downstream.

The Colorado River, with headwaters in the Rockies, serves the entire Southwest. The Rockies are pocked by abandoned mines, and new mineral-recovery schemes are springing up everywhere, encouraged

by this administration's policy toward the use of federal lands. Each mine acts like a horizontal well, providing a new channel for water. The water from the deep interiors of the Rocky Mountains is so highly mineralized that mineral-yellowed streams emerge from many abandoned mines. The streambeds affected by such acidic mine drainage are literally paved from one bank to the other with cobblelike orange mineral deposits.

Acid rain is an additional environmental factor that deserves more consideration than Price gives it. Particulates from industrial smokestacks and vehicles combine in the atmosphere to become acids, which fall with rain and snow. Snowfall accumulated during long mountain winters concentrates these acids. When spring comes, the acids run off in a giant surge, and the bare, mineralized rock and thin soils of mountains offer little buffer. Acids, which pull minerals into solution, further affect the headwaters of major river systems. Surges and pulses of acids from snowmelt also dissolve the yellowboy pavement, putting the heavy metals back into the stream flow where they can do more damage.

Because of the West's need for water, each stream and river is dammed and dammed again. The water from the drainage-affected streams mingles with other water and is piped over irrigated fields, where it picks up more dissolved salts. Each dam creates an artificial lake, and in dry climates, lakes lose water to evaporation at an amazing rate—Lake Mead in Arizona, for example, loses seven feet to the sun annually. This concentrates the mineral salts, further diminishing the water's ability to support life.

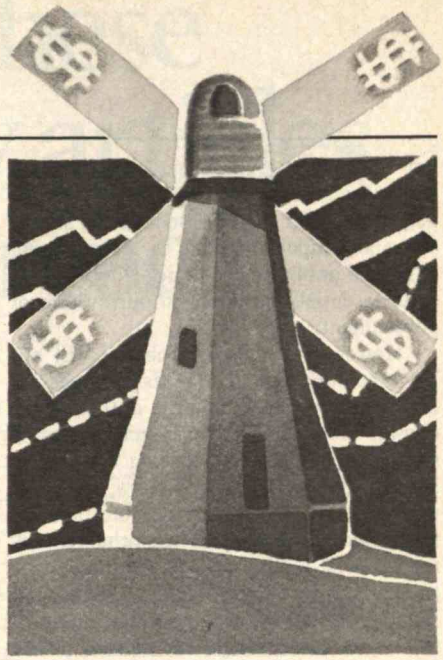
A few college courses on the subject of mountain environments can be found—Price offers one at the University of Portland, and others are offered at the University of Colorado and elsewhere. But at the Colorado School of Mines in Golden, for example, the course in mountain and alpine environments is a poorly subscribed elective. These students are being trained as miners. As insiders, they could help mitigate the effects of industrial development on pristine environments, if only they would first study the natural system they will be disrupting. This book provides a significant step toward that end. □

Sara Jane Neustadtl, formerly managing editor of Technology Review, *is writing a book on mountains and development.*

Retrofitting for Economic Survival

Our Energy: Regaining Control
Marc Ross and Robert Williams
McGraw Hill, 1981, 354 pp, $16.95

Reviewed by Henry Lee



In *Our Energy: Regaining Control*, Marc Ross and Robert Williams reexamine, from a novel perspective, the well-worn arguments for an energy policy based on improved efficiency. The authors propose a merger of the soft-path energy philosophy, with its emphasis on conservation and renewables, with free-market economics, the proponents of which are generally perceived as less supportive of soft-path options.

Ross and Williams' market approach to the energy problem calls for removing government price controls and subsidies on energy sources and replacing them with increasingly stringent taxes on energy consumption. This policy, they argue, would stimulate demand for labor-intensive goods and services while inhibiting demand for energy-intensive products. The authors are fully aware of the political difficulties inherent in this strategy, and they recognize that its potentially regressive nature will require imaginative approaches if it is to have any chance of acceptance. However, given the history of energy tax policy in Congress, the reader cannot help but be skeptical about the viability of this idea.

The concept of increased reliance on market mechanisms to foster decentralized energy options is more persuasive. The authors point out that centrally managed energy programs tend to foster large, centralized projects regardless of their architects' original intentions. One must remember that the three major federal energy-oriented construction programs—the Tennessee Valley Authority, nuclear power development, and synthetic-fuel development—all originated under Democratic presidents.

To an extent, Ross and Williams have taken the ideological argument put forth by Amory Lovins five years ago and mapped a more pragmatic and less combative strategy for implementing it. In the same way that Lovins' arguments fit the political context of the mid-1970s, so do those of Ross and Williams fit the context of the early 1980s. People are now skeptical about the ability of the public sector to realize national goals and are looking instead to the private market.

The energy needs of 1975, when the country was still in shock from the oil embargo, were very different from those of today. With the private sector paralyzed by uncertainty, we looked at government for direction. But the new reality of higher prices and scarce resources has bludgeoned the private sector into action. Those who have resisted change, such as the auto industry and the electric utilities, have ended up bruised and even broken. Today, significantly larger investments in energy efficiency are being made, as evidenced by the auto industry's stated intention to exceed the 1985 federally mandated fuel standards and interest in renewable sources and innovative, community-level programs.

Programs and policies designed to protect the public from the marketplace that may have been valid in 1975 today may only serve to impede this momentum. The present trend toward decentralized government and a stronger reliance on competitive markets should tend to discourage highly centralized projects such as nuclear power plants and synthetic fuels, and tend to promote small-scale alternatives such as investments to save energy. Their recognition of these changing realities sets Ross and Williams apart from many other advocates of low energy growth.

Our Energy: Regaining Control is not a definitive analysis of our energy situation or policies, nor is it a comprehensive assessment of energy-related issues. Rather, it is an effort to provide a broad overview of the energy problem and offer insightful thoughts on its resolution. Its audience is

not the energy expert but the educated generalist who makes most of the major decisions in our society. Books such as this serve an important role by encouraging debate of public-policy issues—debate that is an essential ingredient in our system of government.

However, this book probably will not have the impact of some of its predecessors for three reasons. First, the authors have chosen to write the book backward—the strongest and most intriguing arguments are left for the last two chapters, while the weakest and least-novel sections are up front. Second, the authors lack the marketing flair of earlier energy commentators such as Daniel Yergin, Amory Lovins, and Barry Commoner. Finally, while many of the earlier books caught the wave of public concern at its crest and rode it into prominence, Ross and Williams reached the beach just as the tide was ebbing. The country seems to be suffering from energy-policy saturation, and the current oil glut gives it the liberty to ignore energy issues.

This is unfortunate, for the authors present a set of energy initiatives that would fit comfortably into the contemporary ideological framework, and their ideas deserve public scrutiny. □

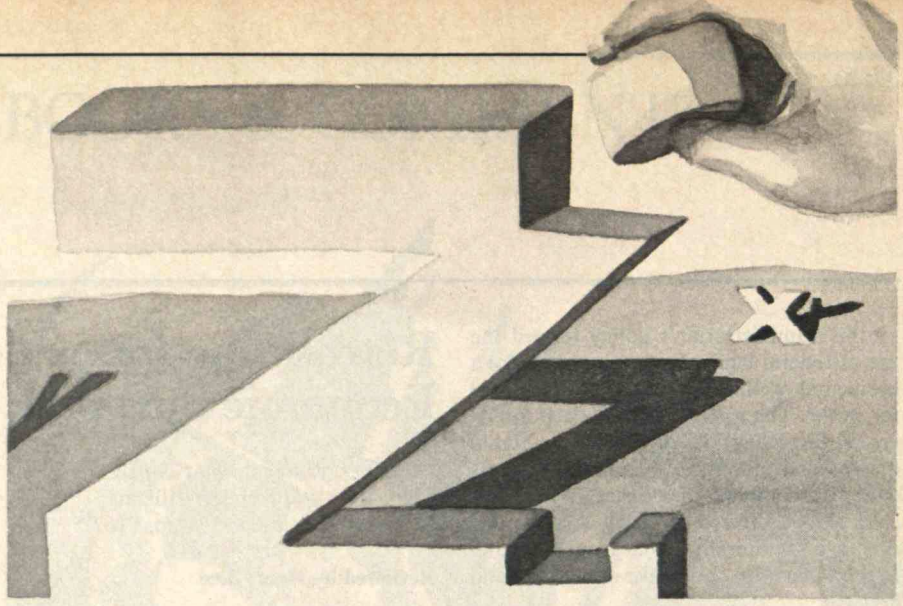
Henry Lee is executive director of the Energy and Environmental Policy Center at Harvard University's John F. Kennedy School of Government.

Easier Said Than Done

Theory Z
by William Ouchi
Reading, Mass.:Addison-Wesley Publishing Co., 1981, 283 pp.

Reviewed by Lester C. Thurow

Although this book is well worth reading, it is not quite what it seems to be. While it is promoted as a study of Japanese management, only two of the book's eight chapters deal with this subject. There is no systematic attempt to inform Americans as to how a typical Japanese corporation works, and there is no analysis of the role of the Bank of Japan and the Ministry of Trade and Industry in industrial decision making. The close relationships between private banks and industry in Japan are left unexamined.



What there is on Japanese firms is interesting, but it does not convey a real sense of what that industrialized nation is all about. Instead, the chapters on Japan are an introduction to the book's main concern: Theory Z. Since Japanese corporations operate closer to the Theory Z model than American corporations, a little information on Japanese businesses is included to make American managers receptive to learning about the theory. If Japanese firms are Theory Z firms and they are out-performing American firms, then American managers should want to introduce Theory Z into their operations.

Theory Z is proposed as an alternative to the Theory X and Theory Y devised in the 1950s by Douglas McGregor, an M.I.T. industrial psychologist. Theory X is based on an authoritarian, harsh-incentives view of human nature: that to enhance productivity, managers must give orders and dole out punishments. According to this theory, people will refuse to work if left to their own devices. By contrast, Theory Y advocates sparing the rod and rewarding the productive worker. Theory Y says people are tool-building, industrious animals who will work unless someone constructs substantial barriers to prevent them from doing so.

Theory Z is touted as an alternative to both these earlier theories, but it is more a management philosophy that embodies the behavioral hypotheses of Theory Y. In Ouchi's and the Japanese view, people are really enthusiastic workers who need to be treated as such. If treated otherwise, they will focus on short-term, self-interested goals destructive to the team needs of a successful business enterprise. Slower promotions, closer cooperation with suppliers, job rotation, long-term goals, more on-the-job training, less turnover, more teamwork—all are touted as ways to embody Theory Z and improve management. While these things are necessary, it is not obvious how they can be achieved.

Ouchi points to some American firms that have successfully followed the tenets of Theory Z (Hewlett-Packard, Dayton-Hudson, Rockwell International), but we are not given enough information to know whether these companies are successful because they practice Theory Z or because of unrelated factors. We are also told very little about the problems of being an isolated Theory Z company in the midst of many Theory X corporations.

Given that President Reagan is essentially recommending a return to a form of Theory X (larger wage differentials, less social insurance, more individual responsibility), America will soon become a testing ground for Ouchi's theory. If he is right, Reagan will not cure American productivity problems; if he is wrong, his scheme will prove successful.

Japanese firms can give seniority wages and slower promotions because all other firms are operating under the same system. Also, it is impossible for workers to move from one firm to another: to quit to look for another job is to signal that there is something wrong with you. Firms hire only young, entry-level workers.

But workers in the United States do not have to wait for an internal promotion—they can move to a new employer. Firms providing training for their workers are often raided by other firms looking for skilled employees. It's difficult and alienating to run a Theory Z firm when most of the work force has learned its rules of personal behavior in a Theory X world. While it may be rational for the whole society to move from Theory X to Theory Y, it is irrational for any individual to do so. Perhaps incentives could be built into the system to motivate individuals to make this switch, but Ouchi does nothing to illuminate them. □

Lester C. Thurow, author of Zero-Sum Society, *is professor of management and economics at M.I.T. and a columnist for* Newsweek.

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Boulding/Continued from p. 9

serve our national states with national defense, they will be destroyed. The cost is too great.

There are times when social institutions pass a watershed and become intolerable and disappear. This happened to serfdom, slavery, and duelling because of basic changes in the systems themselves that made them no longer viable. The whole system and concept of national defense is now at this crucial watershed. Either we must abolish it or it will abolish us, but how to do so is a problem we have not yet solved. When the choice is between the impossible and the difficult, the only appropriate action is to devote our resources to the difficult and quit trying the impossible. ☐

Kenneth E. Boulding is a program director of the Institute of Behavioral Sciences and distinguished professor emeritus of economics at the University of Colorado at Boulder.

Gilinsky/Continued from p. 11

government can do to beef up the commercial nuclear program. But it can take a few modest, practical steps to help protect the country's *existing* investment in nuclear power plants, both operating and under construction—and spent fuel storage is one of them.

The government can and should ensure that spent fuel storage will be available when utilities run out of on-site storage. It is very well to insist that this could be taken care of by the private market, but only the government is likely to organize off-site storage. Utilities may be able to build more on-site capacity, but for modest cost, part of which could be defrayed by utilities, the government can provide some reserve capacity at the back-end of the fuel cycle. This may well be needed, either because reactors run out of storage capacity or because a waste repository is delayed. A Senate bill, the National Nuclear Waste Policy Act of 1981, contains this provision.

Second, there is the matter of insurance. As discovered after the TMI accident, nuclear power plants are badly underinsured. That plant was insured for about $300 million, typical for the industry. The damage was more like a billion dollars—and some plants now being built are worth a lot more.

These facts have not escaped the notice of Wall Street. If the industry wants to regain the confidence of the banking community, it will have to be adequately insured. There has been talk of a billion-dollar private insurance pool, but it has not materialized. Congressman Ertel has introduced a bill to provide for government organization of an insurance scheme, and similar bills have been introduced in the Senate by Senators Heinz and Specter.

A government program would provide retrospective insurance, collecting from member utilities *after* an accident if the cost of damage and cleanup exceeds private insurance coverage. Although the utilities have welcomed the idea of federal assistance to pay for cleanup at TMI, they are oddly cool to government involvement in non-TMI programs to insure against future accidents.

The third item missing from the president's package is any federal plan for cleaning up TMI. I don't mean federal money necessarily, but a larger role in assigning responsibilities. In the meantime, continued uncertainty about the future of the TMI waste and cleanup is not good for nuclear power, yet DOE has still not agreed to accept all the damaged fuel.

All in all, the administration has left nuclear power pretty much where it was before the election. Except for one thing. The decision to tie together reprocessing and waste disposal complicates and delays solution of the radioactive waste problem. The emphasis on reprocessing is a throwback to when dozens of plutonium-fueled breeders were seen around the corner. That is now just fantasy. The administration should accept the fact that our earlier expectations were too grandiose, recognize that 120,000 megawatts of electricity from light-water reactors by the 1990s would be useful, and then take the few reasonable steps needed to protect that investment.

Finally, let me stress that nothing is more important to protecting the public and private investment in reactors than assuring their safety—nothing would be more destructive than another major accident. Yet there is no hint in the administration's statement that the smooth, safe operation of nuclear plants requires significant improvement in industry performance. Instead, there is more than a hint that federal safety regulators don't know what they are doing. That's not going to help on Main Street or on Wall Street, either. ☐

Victor Gilinsky is a commissioner on the U.S. Nuclear Regulatory Commission. This article is adapted from a speech at the World Nuclear Fuel Market's International Conference on Nuclear Energy last October in Washington, D.C.

Can you find the glue in this tree?

We at Boise Cascade haven't been able to...yet.

Trees, you see, are full of glue. It's called lignin, and it holds the wood fibers together.

This means the sheets, or veneers, we use to make plywood are already full of natural adhesives, and yet, we have to apply a glue made from crude oil to get them to stick together.

We haven't been able to find a way to fully activate the lignin those veneers are full of, to "awaken" it, make it sticky.

If we could, they'd stick together naturally, and we'd cut oil consumption and manufacturing costs.

That's why we're working with university and industry groups to find ways to awaken the lignin in those veneers. We're not there yet, but we're getting close.

Working to get glue from trees is an example of our kind of resource management, the kind that produces jobs, products, profits and thriving forests.

Boise Cascade Corporation
Wood and paper for today, trees for tomorrow.

A curiously tenacious molecule that's saving millions

Hal Shaub discovered the molecule's properties at Exxon Research and Engineering Company.

Hal Shaub (Ph.D. Chemistry), Senior Research Associate in Exxon Research and Engineering Company, discovered some curious properties of a molecule in his work to develop fuel-saving motor oils. "It's a very tenacious molecule," Hal says, "sporting a pair of highly polar 'feet' that attach to positive and negative sites on metal surfaces."

Two Kinds of Friction

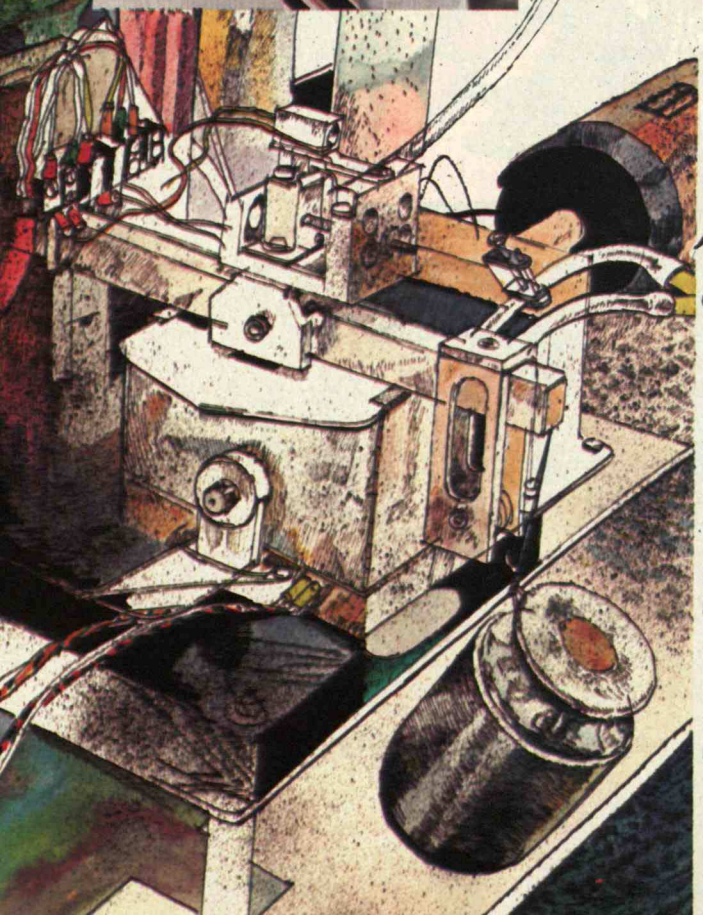
In a typical internal combustion engine, a considerable amount of fuel is consumed in overcoming friction. It has two sources: *rubbing* where lubricant film fails and metal-to-metal contact occurs, and *drag* caused by the viscosity of the lubricant itself. Friction can be reduced by lowering oil viscosity, but there is a point at which friction begins to increase due to failure of the lubricant film and resulting metallic contact. To Hal, this suggested developing sturdier lubricant films.

Hal uses a unique laboratory device to assess additives—Exxon's "ball on cylinder" test that simulates conditions in parts of the engine where lubricant films commonly give way. The test gives positive laboratory confirmation that the curious two-footed molecule reduces friction. But it has also raised puzzling questions about how and why.

Two Theories on How the Molecule Works

The additive that Hal discovered actually seems to chemisorb on steel surfaces, reducing metallic contact under thin lubricant film conditions.

One theory is that this chemisorption reduces adhesive wear, and low friction prevents sub-surface fatigue wear. So stresses exerted by the load cause plastic deformation of rubbing steel surfaces—resulting in smoother surfaces and less friction.



molecule from Exxon of gallons of fuel.

But Hal believes that when metallic parts contact and heat in the presence of the molecule, changes in the metal's chemistry occur. Specifically, the melting point may be lowered, causing surface irregularities to deform in a more uniform way—resulting in lower friction.

Hal adds that various additive chemicals can compete with the molecule for polar sites on the metal, can prevent it from getting to the surface, or both. So for the molecule to work its magic, special chemical techniques must be used to incorporate it into the motor oil.

Mileage Improvements Averaged over 4%

The complete additive technology, in a super premium motor oil, was assessed for overall engine performance in dynamometer and road tests, including a grueling taxi fleet test. Other special road fleet tests demonstrated improvements in fuel economy averaging over 4%, compared to conventional 10W-40 motor oils of the time.

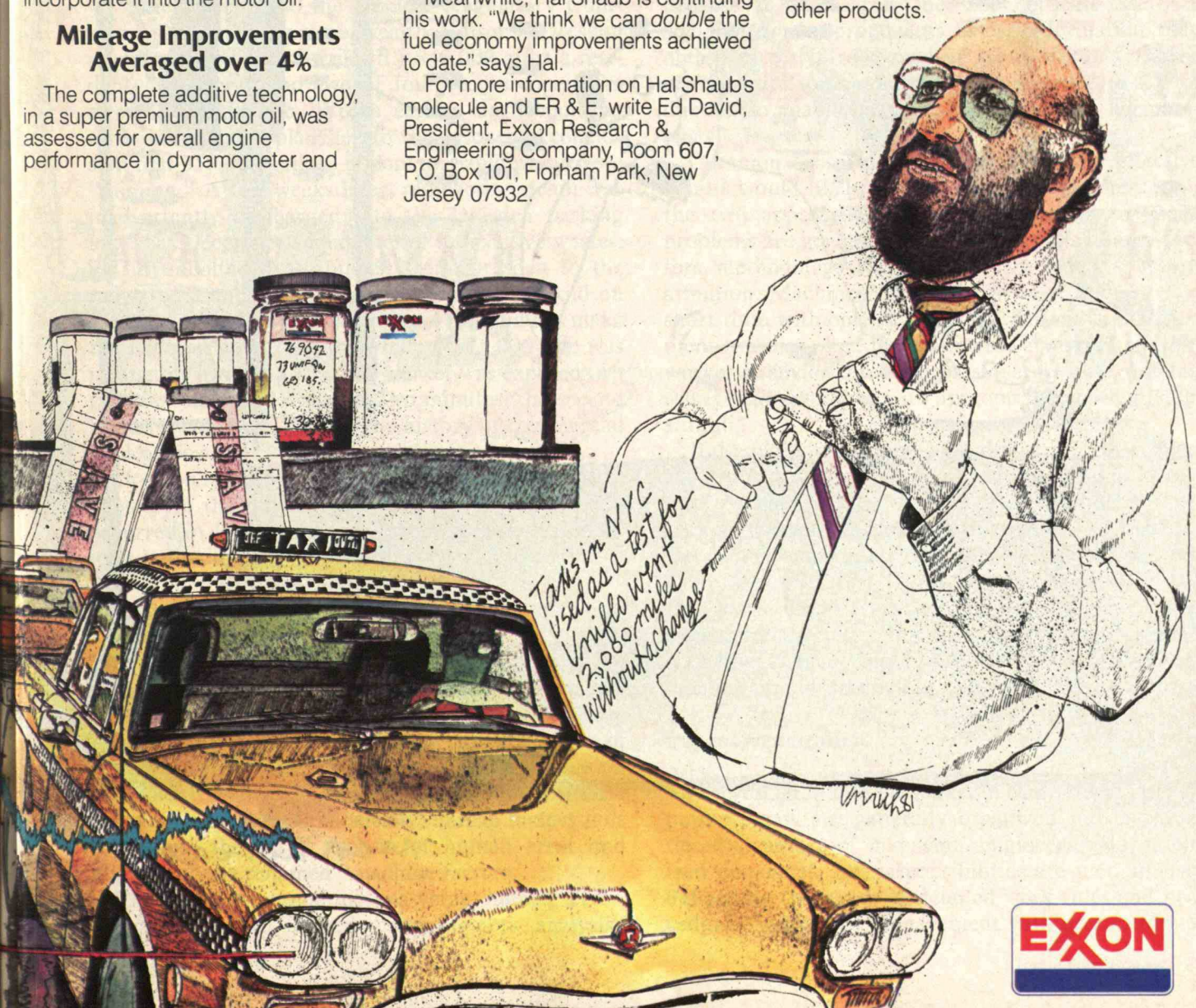
The additive technology has been incorporated in Exxon's *Uniflo*® automotive motor oil since 1977, in heavy-duty oils for diesel engines since 1980, and is now in *Exxon Extra Motor Oil*®. The fuel savings resulting from consumer use of these fuel-efficient oils are estimated at millions of gallons per year.

Meanwhile, Hal Shaub is continuing his work. "We think we can *double* the fuel economy improvements achieved to date," says Hal.

For more information on Hal Shaub's molecule and ER & E, write Ed David, President, Exxon Research & Engineering Company, Room 607, P.O. Box 101, Florham Park, New Jersey 07932.

Exxon Research and Engineering Company

Fuel-saving engine lubricants are just one example of technological innovation going forward on many fronts at Exxon Research and Engineering Company. A wholly owned subsidiary of Exxon Corporation, ER&E employs over 2,000 scientists and engineers working on petroleum products and processing, synthetic fuels, pioneering science, and the engineering required to develop and apply new technology in the manufacture of fuels and other products.



EXXON


McKitterick

To Err Is Human Factors

by Joseph R. Egan

Working relationships, both poorly and overly structured, are the major source of human error in nuclear power plants—and one that is still largely ignored.

In the fall of 1980 the Nuclear Regulatory Commission fined Commonwealth Edison's Dresden nuclear station (in Morris, Ill.) $40,000 after a resident inspector found two of four reactor operators sleeping on the job. Weeks earlier, an accounting error in the same plant led to the erroneous conclusion that 350,000 gallons of contaminated water were "missing." A few weeks later, radioactive steam was inadvertently discharged into the Dresden parking lot. That December a container of radioactive wastes, its lid unbolted, was shipped from Dresden to the radwaste storage facility at Hanford, Wash. And on the evening of March 4, in an event that did not make the national news (but for which a $75,000 fine was ultimately levied), a Dresden worker was exposed to a radiation dose of 21 rems in two minutes, the second largest whole-body dose in the history of commercial nuclear power.

Dresden is but one nuclear station. Similar mishaps abound in the nuclear power industry (some 3,500 occurred in 1980), and a large number are caused, at least indirectly, by "human error."

The Problem Defined

How can human error be prevented? The most popular approach, called "human-factors analysis," is *anthropometric*: its proponents seek to quantify the probability that errors will arise from the actions of individual workers, and on this basis analysts redesign equipment to enable human and machine to coexist harmoniously. But paradoxically, human factors fails to address the social aspects of human error and might aptly be renamed "machine factors."

The second method of analyzing human error, which might be termed "social-factors analysis" because it emphasizes the labor process itself, is *sociometric*: its proponents assess information they obtain directly from nuclear plant workers. These analysts seek to reorganize the social structure of production to enable people to work together harmoniously.

Common sense suggests that the most effective results would likely issue from some combination of the two approaches. However, solutions to social problems are generally political, and thus human-factors methodology has received the lion's share of attention. Machines, after all, can be redesigned in a short time with only minor perturbations in management routines. And human-factors analysts hold that worker behavior can be dispassionately observed and then readily modified with appropriate environmental stimuli.

But equally important, a wealth of information on the human-machine interface in aircraft and spacecraft cockpits as well as tanks, ships, and other military equipment was already available. In fact, much of the controversial content of the Nuclear Regulatory Commission's *Draft Guidelines for Control Room Design* was drawn from such data. The human-factors approach is so compelling that nuclear industry planners have virtually ignored the roles of labor and the organization of production in causing human error.

Paper Organization

The several hundred personnel in commercial nuclear power plants are generally organized into a three-tiered structure of managers, engineers, and unionized personnel. Job responsibilities are meticulously defined by thousands of detailed work rules and procedures, written by management with great effort to

The lines of "paper" authority become blurred during the actual operation of a plant.

clearly establish group turf. These rules also serve to protect workers from losing their jobs as a consequence of technological change. Work assigned to one union group may not be performed by another, and work assigned to engineers may not be performed by union workers and vice versa.

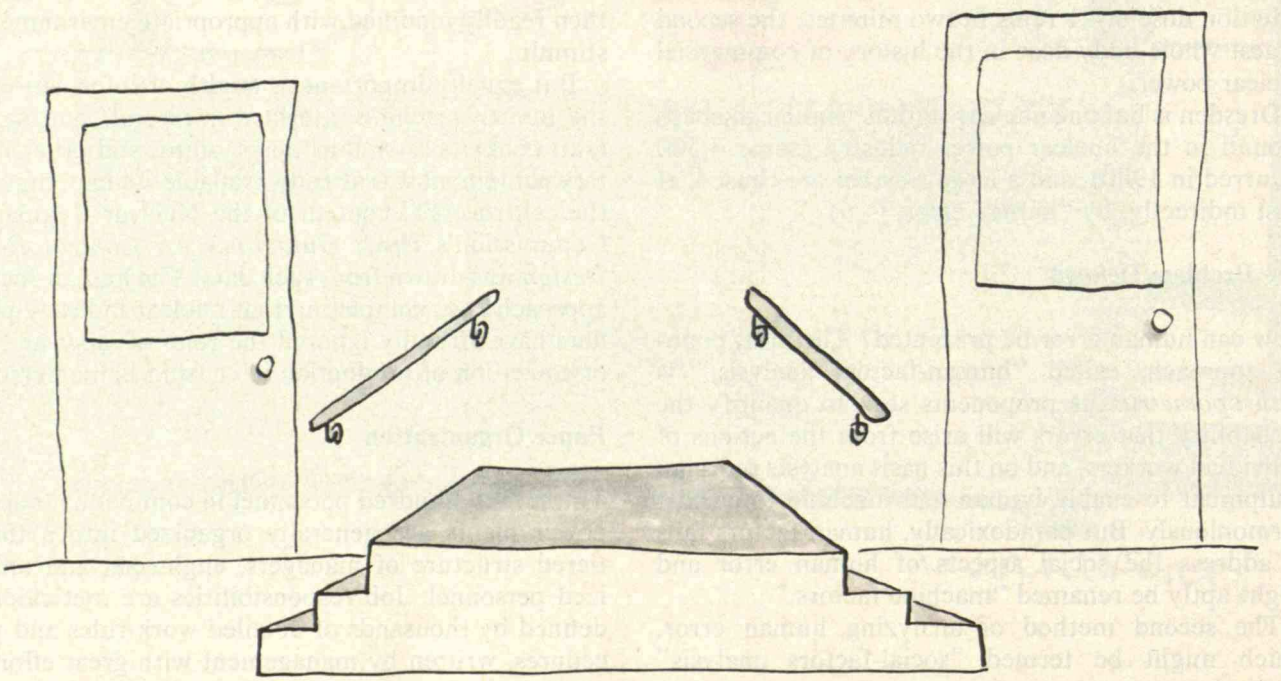
But the lines of "paper" authority become blurred during the actual operation of a plant. For example, engineers are officially regarded as "managers" but typically lack the authority to sign their own paperwork, are usually paid by the hour (sometimes below union pay scales), and often have less authority over plant operations than union personnel.

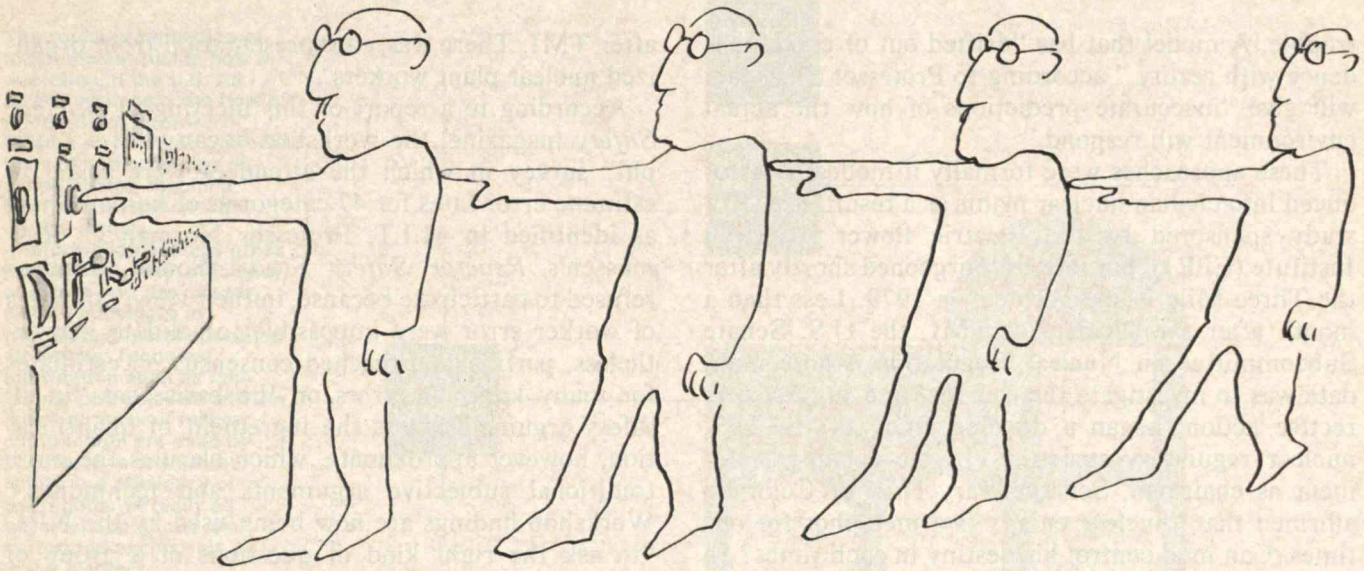
Routine duties are divided into "hand" and "mind" functions and assigned to workers and engineers, respectively. Engineers have no functional authority over plant operations. In general, "work" in a nuclear plant is performed by union workers; only "direction" can be provided by engineers. Thus, reactor operators, who regularly change the power level of a reactor by moving control rods in or out of the reactor's nuclear fuel, are advised by nuclear engineers where to position the control rods and how much power can be produced within the bounds of safety. The knobs, buttons, and switches of the reactor's control panel are off-limits to engineers. Conversely, access to certain of the reactor's computer programs is reserved for engineers by lock and key.

Such a rigid jurisdictional scheme can cause serious problems. Many tasks in nuclear plants clearly require integration of hand and mind for efficient implementation, and the rigid division of labor can hinder rather than help operations.

Consider the plight of an engineer who discovers that an important instrument has drifted out of calibration. Even if the engineer knows that instrument readings are faulty, the only action that can be taken is to summon a union mechanic (who may be on call during the night shift) to turn an adjusting screw—a function the engineer could have performed in seconds. In the meantime, rules prohibit the engineer from checking the power distribution in the reactor core because the technique calls for a device that engineers are not allowed to operate (though they may be as familiar with its operation as union workers). An unoccupied worker must be found—and convinced to do the job. Depending on the relationship with the worker, an engineer may or may not find this an easy task. While all this negotiation is going on, the reactor could well enter an undesirable or even risky state.

But consider the plight of experienced union personnel who must deal with the sometimes ill-informed advice of new and inexperienced engineers, whose average tenure in nuclear plants is typically less than three years. Imagine a worker's frustration over receiving, say, an "overpower" alarm from the reactor core and not being able to evaluate the reason for it because work rules prohibit access to the plant's com-





puter. Instead, the on-call engineer must be summoned for advice. Such mundane incidents accentuate social tensions and erode the quality of communications between union and nonunion personnel.

Because of such conflicting, unclear, and outdated work rules, a vague but pervasive form of common law develops, enforced by the strength of individual or group personalities. Under this law, psychological advantage may outweigh ability, seniority may outweigh performance, and intimidation may outweigh managerial authority. Yet ironically, violations of inefficient but formalized work procedures can lead to union grievances as well as fines and citations by the Nuclear Regulatory Commission (NRC).

The implications of this dilemma go far beyond the realm of routine operations; the resulting confusion also affects occupational safety. For example, in a summer 1980 audit of one Midwestern station, the NRC noted that "unusually strong union-management dichotomy and weak management support for professional health-physics activity have had a pervasive and deleterious effect on the (station's) radiation protection program." The NRC noted that the day-to-day program is run by radiation chemistry technicians (RCTs, who are union members) in virtual autonomy. Moreover, "the foremen provide little day-to-day supervision other than making work assignments, and the health physicists (HPs, who are engineers) are largely prevented from making a meaningful evaluation of program effectiveness because of locally interpreted work rules." For example, one such rule prohibits HPs from using portable radiation-measuring instruments, reserving their use to union personnel.

Among other factors noted by the NRC were a significant rate of turnover of HPs; physical separation of RCTs and HPs, which hampered communication (the engineers were housed in the administration center beyond the gatehouse); inadequate training of RCTs (by their own admission) to perform daily assignments; and frequent staffing of weekend shifts by inexperienced and unqualified personnel. The NRC concluded that "mutual antagonism, disrespect, and lack of cooperation between RCTs and HPs have helped shape a superficial, somewhat outdated [radiation protection] program that appears adequate for routine situations but that may not be under anomalous conditions."

TMI and the Human-Factors Campaign

Seemingly unmindful of this divisive social environment in nuclear plants, human-factors engineers have based their initiatives on two behavioral theories of why human error occurs in complex technological systems. The first theory, as expressed by Thomas Sheridan, professor of mechanical engineering at M.I.T. (*see "Human Error in Nuclear Power Plants," February 1980, page 22*), holds that people make errors when "the physical or social environment does not provide enough feedback signals about the conformance of their behavior to what is expected of them." The other theory maintains that faulty "conceptual models" in the minds of workers can lead to

The labor-management dichotomy has long been recognized by the NRC as a critical safety concern.

trouble. A model that has "drifted out of correspondence with reality," according to Professor Sheridan, will give "inaccurate predictions of how the actual environment will respond."

These approaches were formally if modestly introduced into civilian nuclear plants as a result of a 1975 study sponsored by the Electric Power Research Institute (EPRI), but interest burgeoned shortly after the Three Mile Island accident in 1979. Less than a month after the accident at TMI, the U.S. Senate Subcommittee on Nuclear Regulation, whose mandate was to investigate the accident and suggest corrective action, began a detailed study of the U.S. nuclear regulatory structure. In his opening statement as chairman, Senator Gary Hart of Colorado affirmed that "nuclear energy is a metaphor for our times. Can man control his destiny in such times? In peaceful and military uses, we will either learn to control high technology or technology will control us." The popular notion that modern technology is somehow "out of control" was the focal point for this and other post-TMI investigations, which placed renewed emphasis on the machinery of nuclear generation.

What emerged from this and other studies were recommendations and regulations designed to "reassume human control over nuclear technology." The NRC's TMI "Action Plan" called for a "detailed control-room design review." Existing control panels were suddenly deemed archaic and confusing. Topics such as control-room humidity, dial markings, instrument pointers, color, glare, reflectance, reverberation, and the shape and friction of control knobs became fashionable overnight.

The American Nuclear Society, a nonprofit industrial organization of 12,000 scientists, engineers, and educators, promptly added a human-factors division to its roster of technical study groups. And Brookhaven National Laboratory, together with the NRC and the Institute for Electrical and Electronics Engineers, began a series of workshops to investigate the role of human-factors engineering in combatting human error in the nuclear power industry. The first of these workshops, attended by 81 analysts (many of whom had little or no plant experience), met nine months after TMI. There was no representation from organized nuclear plant workers.

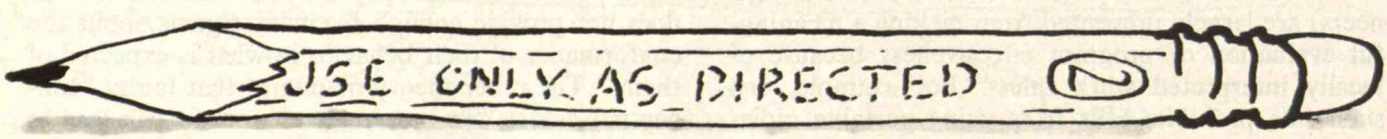
According to a report of this meeting in *Nuclear Safety* magazine, the workshop began with a "Delphi" survey in which the attendees were asked to estimate error rates for 47 categories of human error, as identified in M.I.T. Professor Norman C. Rasmussen's *Reactor Safety Study*. Some attendees refused to participate because, in their view, estimates of worker error were impossible to validate. Nevertheless, participants reached consensus on estimates for many kinds of errors on the basis that "in all safety arguments, it is the ingredient of quantification, however approximate, which clarifies the more traditional subjective arguments and techniques." Workshop findings are now being used by the NRC "to ask the right kind of questions of a group of human-factors experts to get a consensus estimate for use in promulgating regulatory policy."

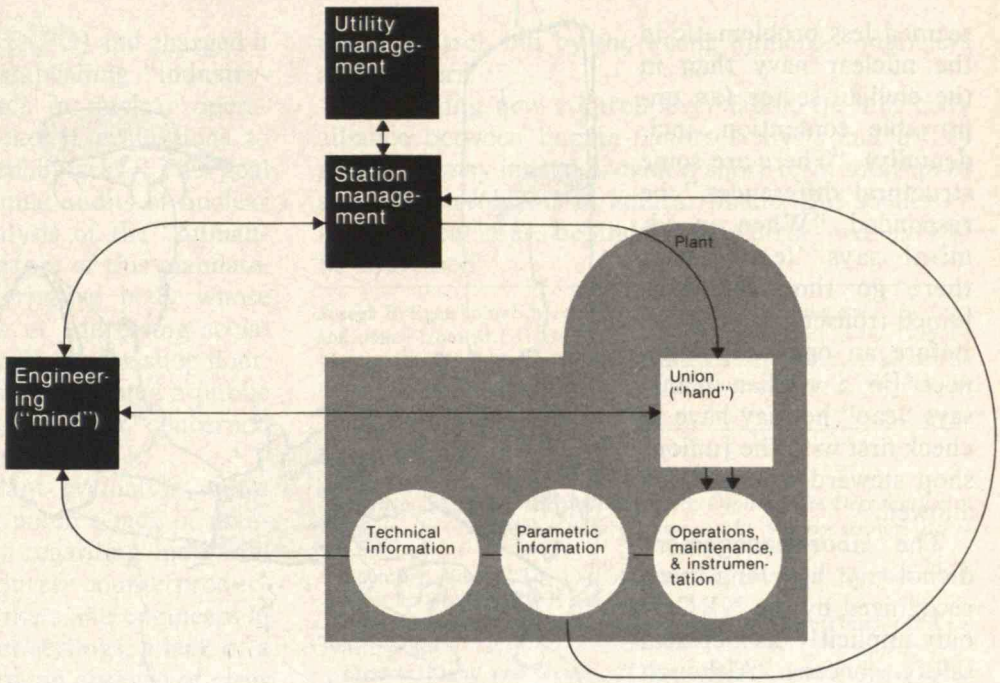
"Conceptual error" also received its fair share of scrutiny after TMI: the NRC demanded a tougher passing grade on operator licensing exams (and added some questions pertaining to thermodynamics). New regulations called for the establishment of technical information centers to make data readily available to managers and regulators during emergencies.

By far the most innovative attack on "conceptual error" was the creation of a new post: that of the shift control room engineer (SCRE, or shift technical advisor), an around-the-clock control-room post to be filled by degree-holding engineers who would monitor operations. No ordinary engineer, an SCRE must have a comprehensive understanding of the intricacies of nuclear machinery and be someone for whom "conceptual misalignment" is deemed improbable. Like *Star Trek*'s fictitious Mr. Spock, this human "bureau of standards" serves as a control for presumably less conceptually sophisticated union workers.

Utility Reaction

The two-theory human-factors paradigm was initially rejected by nuclear plant managers. Some suggested that the changes would exacerbate labor-management tensions and add confusion, *increasing* the frequency





OMNIGRAPHICS

The social organization of most nuclear plants now in operation in the U.S. All arrows represent the flow of information; downward-flowing arrows also represent lines of authority. The so-called human-machine interface is labeled with double arrows.

Information such as gross power level, time, efficiency, and core flow are used by station managers to formulate general operating strategies. Technical information such as fuel-bundle power levels and the leak-tightness of reactor components are used by engineers to ensure the safety and efficiency of operations. Virtually all physical operations are performed exclusively by union workers.

of worker error. Moreover, more comprehensive efforts to battle human error would likely be considered redundant or even spurious.

Other managers pointed to the recent analysis of the 23,000 Licensee Event Reports covering all reportable incidents in U.S. nuclear plants from 1972 through 1978, as reported in *Power Engineering* magazine. Some 4,000 of these were related to faulty human—not machine—performance. Of these, only three were caused by obvious human-factors failures; an operator's reaching for the wrong control because of location, shape, or color, for example. Indeed, the analysis suggested that the most needed improvements were organizational and social, such as restructuring of protocols between maintenance and operations staffs and between engineering and instrumentation staffs.

Even more important, utility managers are well aware of the social conflicts that occur as part of the production process. But they are motivated to address these conflicts only when they interfere, as they now do, with the orderly functioning of their plants. For utilities, such shop-floor problems involve costs and controls, not the redesign of machinery or the retraining of personnel. This is evident in the utility reaction against the "conceptual error" theory and particularly the SCRE requirement.

Shift control-room engineers now receive comparable doses of training in technical operations and manipulative behavioral techniques. The polished SCRE learns to speak only when behavioral science guarantees a positive response from labor. In this way, it is hoped that this engineer's real lack of authority over control room workers will be less obvious.

Utilities have nonetheless endorsed the human-factors campaign, although it excludes organized labor. This ostensible alliance between the human-factors analysts and the utilities was brought about by a desire for what professional conflict managers call a "win/win outcome." Through careful collaboration in the implementation of human-factors innovations, both human-factors proponents and utility managers are meeting seemingly disparate objectives. Tighter controls over labor accompany redesign of the control room. Implementation of the SCRE function and other human-machine innovations reflect the assumption that people, not machines, must be subdued, and that greater managerial control over the production process will result.

The Neglected Social Factor

At an NRC "lessons-learned" conference held a year after TMI, then former NRC Chairman Joseph Hendrie (who subsequently was briefly reinstalled in that post) was asked why the management of reactors

seemed less problematic in the nuclear navy than in the civilian sector (an unprovable contention, incidentally). "There are some structural differences," he responded. "When an admiral says 'leap!' why, there go those bell-bottomed trousers into the air. Before an operating engineer [in a civilian plant] says 'leap!' he may have to check first with the [union] shop steward to see if it's allowed."

The labor-management dichotomy has long been recognized by the NRC, if only implicitly, as a critical safety concern. Although this connection did not surface in post-TMI investigations, it was discussed behind the scenes, according to Edwin Zebrowski, former director of EPRI's new Nuclear Safety Analysis Center. He noted that "questions like 'Why was discipline lax?' 'Why were human errors made?' and 'Why weren't procedures followed?' can have answers that range from inadvertent carelessness to industrial sabotage." However, he also reported that one of General Public Utilities' top executives admitted that "organizational jealousies and union restrictions" contributed to the mishap at TMI.

These social elements are not only difficult to model but impossible to quantify. Superior human-factors engineering will not prevent operators from sleeping on the job or cheating on exams (as was the case at TMI), engineers from quarreling with shop stewards, and supervisors from ordering workers to violate apparently needless procedures. The prevalence of such human problems in nuclear plants begs for a more holistic approach to human error.

The division of labor in U.S. plants contrasts with that in several European countries, notably France, where engineers and workers are members of the same labor union. The union of French nuclear-power professionals (la Confederation Francaise Democratique du Travail) is a major force in the assessment of production-level technology, and perhaps the country's strongest nuclear safety lobby (*see "The French Nuclear Harvest" by Irvin C. Bupp, November/December 1980, page 30*). The French system encourages disclosure of social conflicts between labor and management at the bargaining table. In the United States, conflicts between engineers (technically, managers) and labor are more likely to arise on the shop floor.

The Final Chapter

Three Mile Island showed the urgency of grappling with the problem of human error, but this urgency surely posed a dilemma to utilities, for its resolution could not be more uncertain and costly. The industry was already burdened by declining profits, powerful unions, the threat of organization among engineers, and the lack of control over many physical operations owing to union bargaining and the division of labor. Uncovering the full scope of human error might only spark a highly political debate that would rekindle age-old questions such as: Who decides what is safe or unsafe? What type of social organization is most conducive to safe operation? Why have hand and mind responsibilities been split? Why do nuclear plants have such a high turnover of technical personnel?

But the human-factors campaign ended substantive debate over human error before it ever began. Thus, utilities were left to solve social problems in nuclear plants by themselves, without benefit of public discussion.

The utilities' effort began during the summer after the TMI accident, when they organized the Institute

Organizational jealousies and union restrictions contributed to the mishap at TMI.

for Nuclear Power Operations (INPO) and charged it with the general purpose of establishing "industry-wide benchmarks for excellence in nuclear operations" and conducting "independent evaluations to assist utilities in meeting the benchmarks." This goal was to be achieved through annual audits of nuclear plant operations, including analysis of the "human-factors aspect of design." By virtue of this mandate, INPO became the only authoritative body whose charter included the possibility of addressing social and institutional problems that arise on the shop floor. The establishment of INPO thus preempted a public investigation that many utilities were concerned would be the inevitable aftermath of TMI.

INPO's first preliminary plant evaluation, completed in the summer of 1980, noted a lack of management support and authority regarding industrial safety rules and station procedures, counterproductive separation of unionized workers and engineers in reviewing changes in instrument settings, a lack of a preventive maintenance program, an absence of clear lines of responsibility for each level of plant management, a lack of cleanliness and order in shift operations, and questionable approaches to radiation protection.

However, the organization's final report was considerably more restrained. *Electric Light and Power* magazine, discussing INPO's findings, noted that this utility "will be able to comply with most of the recommendations by merely writing reports, not changing the way it operates the station."

But despite the potential of INPO and the human-factors campaign to provide an excuse for utilities to stand by traditional organization of production, utility managers are attacking the real social factors associated with human error and inefficiency. Their pragmatic focus is on reducing costs and tightening controls over the labor force (including in this context, engineers).

Management's viewpoint seems to be that nuclear technology has never been and never will be "out of human control," so that human-factors approaches to mitigating human error are little more than costly nuisances. In the managerial view, technology is under control, but by the wrong humans—engineers and workers.

By forging new controls over labor, the unsteady alliance between human-factors analysts and utility managers may indeed provide a short-term solution to shop-floor problems in nuclear plants. But sooner or later the real issues behind "human error" will have to be addressed.

Joseph R. Egan holds S.M. degrees in nuclear engineering and technology and policy from M.I.T. He has been a reactor engineer at the Dresden Nuclear Station in Morris, Ill. and held station certification. At present he is a private consultant and is completing a novel, *Pillars of the Pantheon.*

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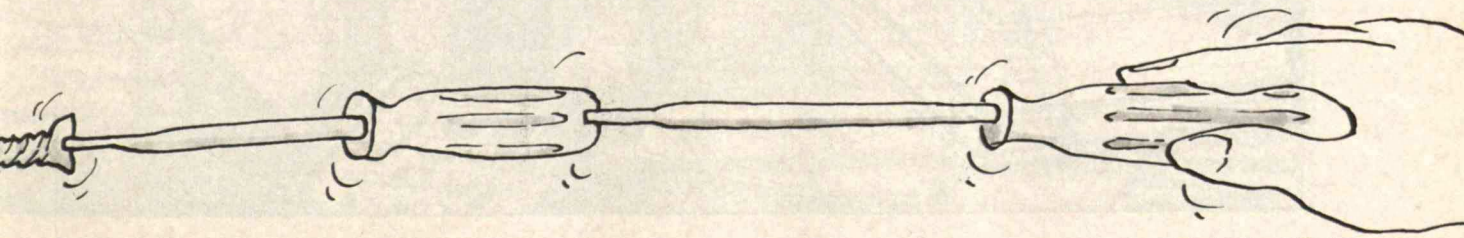
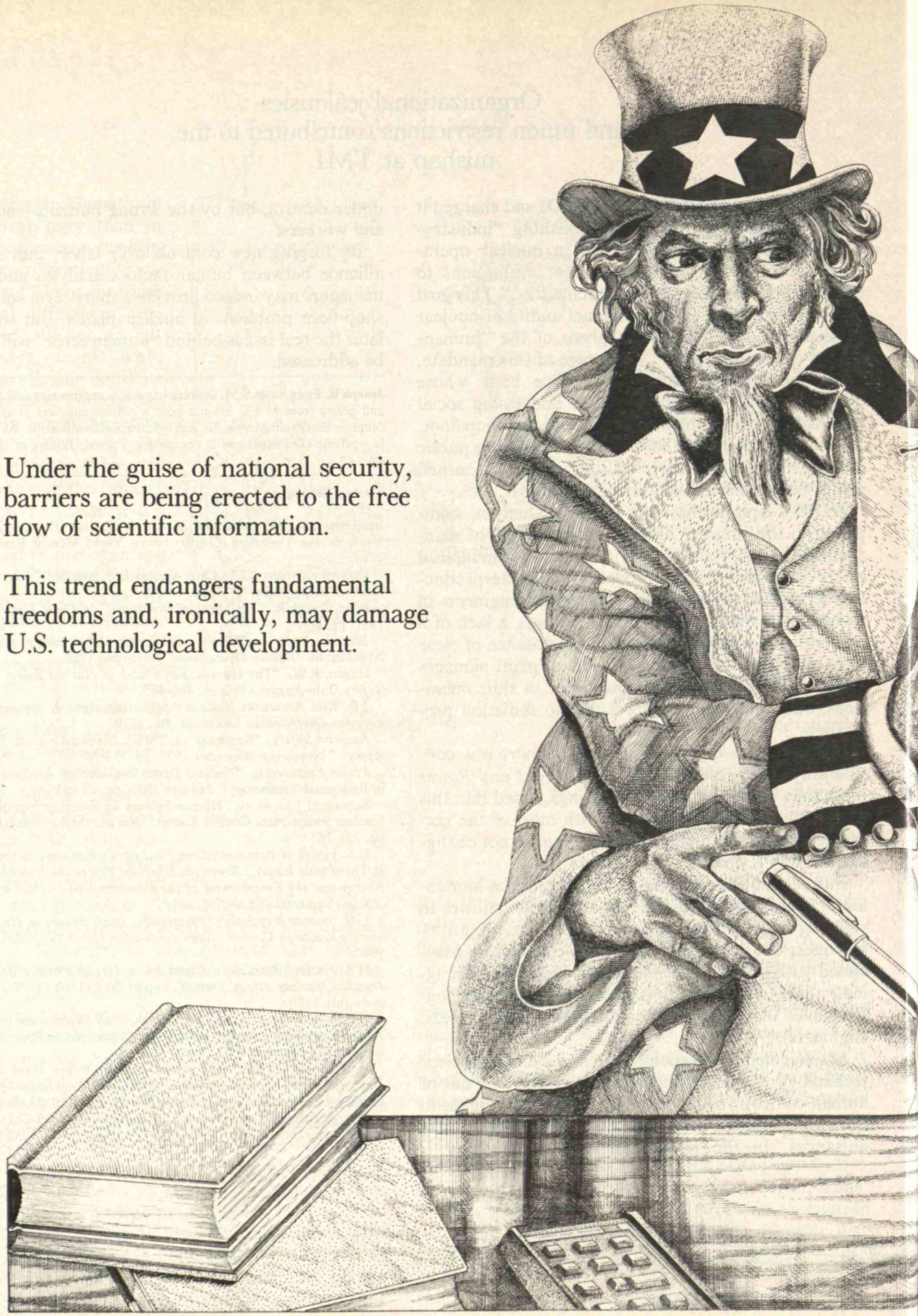


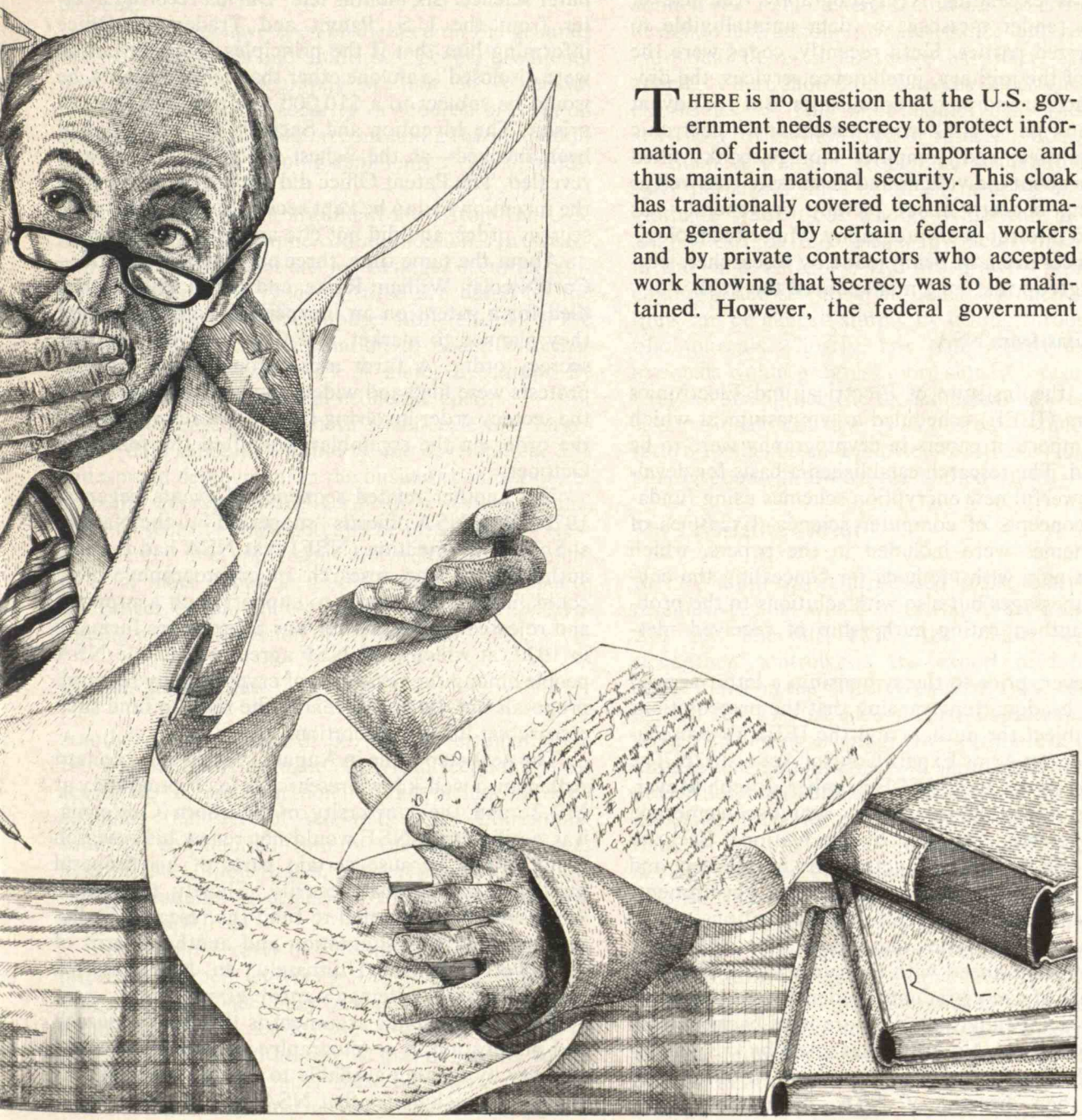
Under the guise of national security, barriers are being erected to the free flow of scientific information.

This trend endangers fundamental freedoms and, ironically, may damage U.S. technological development.



The Growing Threat of Government Secrecy

by Stephen H. Unger



ILLUSTRATIONS: ROGER LEYONMARK

THERE is no question that the U.S. government needs secrecy to protect information of direct military importance and thus maintain national security. This cloak has traditionally covered technical information generated by certain federal workers and by private contractors who accepted work knowing that secrecy was to be maintained. However, the federal government

Clearly, any field closed to foreign nationals would progress more slowly, a result hardly likely to strengthen national security.

has recently attempted to extend its control to include a much broader class of knowledge generated by non-governmental investigators whose projects are not directly related to national security. The underlying concept is that certain ideas may be declared secret regardless of their origin, and that publication of those ideas may be declared unlawful.

An important area in which government-imposed security is expanding is cryptography, the use of codes to render messages or data unintelligible to unauthorized parties. Until recently, codes were the domain of the military, intelligence services, the diplomatic corps, and puzzle enthusiasts. But the advent of nationwide digital communications, electronic funds transfer, and computer storage banks filled with data about individuals and businesses—as well as a growing concern about privacy in general—has expanded interest in cryptography. Major technological advances are now being made by researchers outside the group that long monopolized the field.

Suggestions from NSA

In 1977, the Institute of Electrical and Electronics Engineers (IEEE) scheduled a symposium at which several important papers in cryptography were to be presented. The research established a basis for developing powerful new encryption schemes using fundamental concepts of computer science. Examples of such schemes were included in the papers, which dealt not only with methods for concealing the contents of messages but also with solutions to the problem of authenticating authorship of received messages.

However, prior to the symposium a letter arrived at IEEE headquarters warning that the presentations might subject the authors and the IEEE to prosecution under the Arms Export Control Act of 1976. The letter was signed by an IEEE member, Joseph Meyer, who gave only his home address—but it soon emerged that Meyer was employed by the National Security Agency (NSA), whose functions are to intercept and decipher the communications of foreign governments and to safeguard the secret communications of the U.S. government. After due deliberation, the IEEE nervously went ahead with the symposium, although the papers of some graduate students were presented by their faculty advisors to ensure legal backing from their universities. No action was taken by the government. (It should be noted that Vice-Admiral B.R. Inman, then director of NSA, denies that NSA attempted to suppress scholarly work in cryptography, citing a Senate committee finding that Meyer's letter to the IEEE was a personal initiative.)

Two other cases occurred that year. In October, the University of Wisconsin at Milwaukee filed a patent application (through an affiliated foundation) for an encryption device invented by George Davida, associate professor of electrical engineering and computer science. Six months later Davida received a letter from the U.S. Patent and Trademark Office informing him that if the principles of his invention were disclosed to anyone other than federal agents, he would be subject to a $10,000 fine and two years in prison. The Invention and Secrecy Act of 1951 had been invoked—at the behest of NSA, it was later revealed. The Patent Office did not indicate how long the invention had to be kept secret, did not justify the secrecy order, and did not cite an appeals procedure.

About the same time, three engineers in Seattle—Carl Nicolai, William Raike, and David Miller—had filed for a patent on an inexpensive voice scrambler they planned to market, and they received a similar secrecy order. A furor arose around both cases as protests were filed and widely reported. In June 1978 the secrecy order involving Davida was rescinded, and the order on the scrambler was lifted the following October.

Yet another related sequence of events began in 1975, when NSA officials "suggested" to the National Science Foundation (NSF) that NSA had the sole authority to fund research in cryptography. NSF could find no legal basis to support such a proposal and rejected it. The matter was raised more formally in 1977, at which time NSF agreed to include NSA people among the reviewers of cryptography research proposals but did not surrender the right to fund such research at its own discretion.

The next step came in August 1980, when Leonard Adleman, a well-known researcher in cryptography at M.I.T. and the University of Southern California, was notified that NSF would not renew his research grant in full because certain parts of his proposal impinged on national security. Shortly thereafter, NSA said that it wanted to fund the research. Adleman rejected this suggestion and another storm of controversy ensued. Ultimately, an NSF internal review restored Adleman's entire grant.

The government's argument is that open research and publication in cryptography jeopardizes national security by making available to foreign governments encryption techniques that NSA would have difficul-

Foreign students who return to their own countries constitute a significant pool of goodwill toward the United States.

ty breaking, calling to the attention of foreign governments the vulnerability of their current encryption methods, and revealing knowledge that might endanger the inviolability of codes used by the U.S. government. Although not openly admitted, a fourth motivation can be inferred—that private development of unbreakable codes would make it more difficult for the government to carry out surveillance of American citizens.

These points have been challenged on the grounds that the knowledge and abilities of people producing new ideas in cryptography are not an American monopoly. Also, the security of modern encryption systems does not depend on concealing the methodology but merely on keeping confidential "keys" necessary for decoding.

Another important argument flows from the U.S. dependence on electronic communications. In particular, financial transactions increasingly occur as digital messages. New types of fraud are based on the manipulation of data in computer storage banks or the interception and transformation of coded information, raising the possibility of major disruption by foreign agents and national economic chaos.

One defense against both small-scale and large-scale "data sabotage" would be the development and widespread deployment in the business community of powerful encryption and verification systems. Thus, national security could actually be impaired by excessive secrecy in cryptography research. This technology is far more important to the United States than to the Soviet Union, which lags far behind in the processing and transmission of digital data.

Campus Restrictions

Another manifestation of growing governmental secrecy is the effort to make American technology less accessible to foreign nationals. This includes federal demands that certain scientists from Communist countries be excluded from international conferences held in the United States, and proposals to exclude foreign students at American universities from research in key areas.

For example, early in 1981 the State Department informed Cornell University that a Hungarian engineer must limit his study of electronics to the classroom—no private seminars or discussions would be permitted, nor could he receive prepublication copies of research papers. Under these conditions, the visit was canceled. Another incident occurred at M.I.T. when the State Department expressed concern that a Chinese physicist participating in an official exchange program might be exposed to information covered by export control regulations. And at Stanford University, the research program of several visiting Chinese scholars working in computer science was questioned. A letter from the State Department suggested that the program "emphasize academic as opposed to applied research." There should be "no access to the design, construction, or maintenance data relevant to individual items of computer hardware," the letter added. "There should be no access to design of microelectronics . . . This office should be advised prior to any visits to any industrial or research facilities."

Such restrictions jeopardize academic freedom, since perhaps a third of all engineering and science graduate students at leading American universities are not U.S. citizens, and many faculty members are in the same category. (So are growing numbers of engineers and scientists in industry.) Their contributions can be gauged simply by leafing through scientific journals. Clearly, any field closed to foreign nationals would progress more slowly, a result hardly likely to strengthen the technological base of America's national security. Also, foreign students who return to their own countries constitute a significant pool of goodwill toward the United States.

The Legislative Threat

In 1981 a bill was reintroduced in the House of Representatives that would alter the Arms Export Control Act. The bill—H.R. 109—would significantly strengthen controls on the export of information about items on the "U.S. Munitions List" established by that act. The list covers a broad spectrum of technology, including cryptography, computers, and communications equipment. And significantly, H.R. 109 proscribes *publication*: "Notwithstanding any other provision of law, information specified in such regulations, or materials revealing such information, shall not be published or disclosed unless the secretary of defense, in consultation with the secretary of state and the secretary of energy, determines that withholding thereof is contrary to the national interest."

According to Representative George E. Brown, a member of the House Committee on Science and Technology, "This literally gives the secretary of defense unlimited powers to control, restrict, or forbid communications of any kind, technical or other-

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U.S. Export Controls and Soviet Technology

by Thane Gustafson

ALARMED by the rapidly growing military strength of the Soviet Union, we wonder uncomfortably whether we have inadvertently contributed by exporting scientific knowledge and advanced technology. A decade ago, confident of our military strength and the superiority of our civilian technology, and hopeful about the possibilities of cooperation with the Soviet Union, we began dismantling the virtual trade embargo maintained against Eastern Europe for nearly 20 years and set about expanding trade and contacts. We are far from that optimism now. And export controls are being reconsidered as part of a general rethinking of the premises of American policy toward the Soviet bloc.

The major weakness of the present system of controls, in the view of its critics, is that it allows important technology to slip through to our military competitors by paying too much attention to the export of products, and not enough to the control of broader technologies and management skills. Consequently, the most recent U.S. legislation—the Export Administration Act of 1979—mandates the development of a review procedure that will control classes of "critical technologies" rather than individual products. And the focus is on "active" mechanisms of transfer such as training agreements, long-term technical exchanges, extended workshops, and other apprenticeship arrangements.

Technology Roll-Call

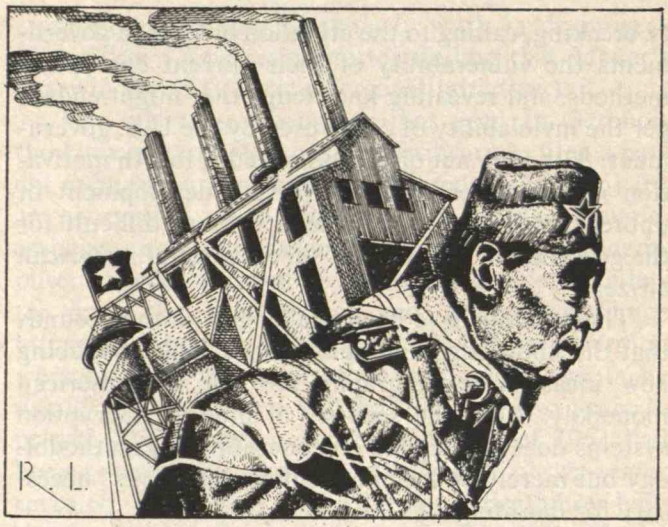
However, there is serious question whether the critical-technologies approach will improve the export-control system. On the contrary, if we are not careful it could make the system more complex, cumbersome, and controversial. The initial "Military Critical Technologies List," issued in October 1980 by the Department of Defense, illustrates the danger: it contains a virtual roll-call of leading contemporary technologies. If this collection had automatically become the basis for the official Commodities Control List (as some urged during the debate over the 1979 Export Administration Act), the entire Department of Commerce would not have been large enough to administer the export-control program. Fortunately, the initial list had advisory status only and will certainly undergo refinement before becoming policy.

What exactly are we trying to prevent the Soviets from doing? In what ways does imported Western technology enable the Soviets to do the things we fear? Can export controls stop them or slow them down? These questions are central to any export-control policy, but there has been considerable confusion among American policymakers about all of them.

What is most critical about technology transfer is whether the receiving side is able to absorb the technology, diffuse it beyond one or two showcase locations, and build upon it to generate further technological advances of its own. Only then does technology transfer have its most lasting consequences.

In certain sectors (notably military) where Soviet technological skills are already high, the Soviets' ability to learn from foreign technology is also high. Here, then, is a clear case for export controls. Something like the present system of case-by-case evaluation, aimed at preventing immediate military use of American technology by the Soviets, must and undoubtedly will continue.

But more pressing is what to do about the possibility that



the U.S. is giving away indirect military advantages through subtle channels that may call for more subtle defenses. The danger is not so much the possibility of sudden and disastrous giveaways, but rather that high-technology trade may help the Soviets gradually upgrade the traditionally neglected "civilian" industries that will provide broad, infrastructural support for new weapons systems.

In these lagging industrial areas in which most Soviet imports of foreign technology are concentrated, the Soviets' record in absorbing and learning from it is poor. The reasons—similar to the ones that caused those areas to lag in the first place—lie deep in the political and economic structure of the country, and numerous reform measures in Soviet technology policy over the last decade have not altered them. Neither have high-technology imports visibly improved the Soviets' ability to innovate; in some instances the opposite has happened.

Industrial managers in the Soviet Union are not rewarded for innovating; in fact, they may be penalized. Bonuses result from meeting very tight production targets, and failure to meet those targets will jeopardize their careers. So the incentives lead managers to gear production toward established, "safe" technologies. Official efforts to mandate innovation by building targets into production plans have resulted in ruses such as "paper" innovation—inflated figures that look good on yearly reports but that do not reflect real gains in productivity.

Other problems in the civilian sector include a lack of experienced entrepreneurs who can "sell" the results of research to industry, a scarcity of new materials and supplies, and difficulty in obtaining "nonstandard" equipment from separate ministries. Innovation is further retarded by administrative and physical barriers—research and design institutes, pilot plants, and factories are seldom under the same roof and may even be in different administrative jurisdictions with conflicting outlooks and priorities. The flow of ideas, labor, and supplies across these institutional gaps is impeded by the fairly primitive state of copying and communciations technology and other bureaucratic hurdles.

The effects of internal Soviet obstacles, in fact, dwarf those of the most stringent embargo the Western powers might devise. Consequently, so long as Soviet policies for technological innovation remain as ineffective as they are now, the claimed benefits of any expansion of U.S. export controls should be examined very carefully. Export controls can have important if marginal political benefits, but they also have serious costs, and the task is to arrive at a balance.

Exports: A World View

Keep in mind that the U.S. is a small player in the total volume of Western high-technology exports to the Soviet Union. Our exports in 1979 amounted to $183 million ($270 million to Eastern Europe as a whole), about one-tenth the level of Soviet imports of advanced machinery and equipment from West Germany, France, and Japan combined. The chances of gaining much support from other countries for an expanded system of export controls are small and growing smaller, for among the nations conducting high-technology trade with the Soviet Union are not only NATO allies (whose reluctance to apply stiffer export controls is long-standing), but also countries such as Austria, Sweden, and Switzerland, which are unlikely to cooperate at all. Thus, we should not imagine that expansion of export controls would be free of serious political costs; indeed, such a move might be unenforceable at any acceptable cost.

History teaches that the control of technology transfer is at best a rear-guard action, achievable (and then only briefly) at the cost of regulations and secrecy that carry harmful side-effects. Balancing the political costs and benefits of export controls requires weighing their claimed effects against their costs in straining relations with allies and impeding the competitiveness of our exports.

Our first concern should be to remain good innovators ourselves. The case for export controls is strongest in areas in which the Soviet Union stands to make near-term military gains and in which the United States has a clear lead over other Western countries. As one moves outside this zone, toward technologies that afford the Soviets longer-term industrial gains and that are not areas of clear American superiority over the rest of the West, the benefits of export controls become more diffuse and uncertain, while the costs of trying to enforce them become greater. Thus, any widening of export controls outside the first range into the second should be undertaken only with the greatest care.

One issue I have not addressed is the use of embargoes or other selective controls on East-West trade as political levers to influence Soviet behavior in the international arena, or as symbolic statements of American positions. I do not necessarily quarrel with such uses of export controls; that is a question for the political process. But it is important to know whether export controls are effective in their *stated* aim (namely, to preserve military lead-times and national security), to clarify what those aims imply in operational terms, and to know the costs. □

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wise! This is so because the Munitions List is written in fairly broad language, and because of the customary leeway in the words 'in consultation with' and 'national interest.' "

Indeed, the proposed bill would restrict the publication of a substantial portion of American research results, since prior approval would be required in areas such as lasers, computer circuitry technology, computational complexity (possibly related to cryptography), and high-energy particle beams. An extraordinary aspect of H.R. 109 is that it places the burden of proof on those who wish to publish, rather than requiring the government to make a case against publication. And scientists must show not only that publication would not be damaging but also that *failure to publish* would be "contrary to the national interest."

H.R. 109 has been referred to the Subcommittee on International Security and Scientific Afffairs of the House Foreign Affairs Committee. Comments have been requested from the Departments of Defense, State, Energy, and Commerce, but no hearings have yet been scheduled.

The council of the Association for Computing Machinery approved a strongly worded resolution condemning H.R. 109 and its underlying philosophy. This resolution was recently endorsed by the IEEE Computer Society. Although such an extreme law as H.R. 109 may be unlikely to pass, the fact that it was introduced in two successive sessions of Congress makes this a serious matter. That the bill's sponsor is Charles E. Bennett, ranking Democrat on the Armed Services Committee, adds further weight.

Does Secrecy Promote Security?

U.S. military strength has long rested on the country's powerful industrial structure and American technological prowess. However, U.S. scientific supremacy has recently come into question in a number of important fields, both commercial and military. For example, Japan and West Germany have surpassed American firms in certain aspects of microelectronics. More worrisome, the Soviet Union —once nearly a decade behind in electronics—has closed the gap to perhaps five years. Meanwhile, the performance of American industry in the area of military hardware has flagged. Failures to meet cost estimates and delivery dates, as well as operational unreliability, are evident in America's latest efforts to develop new tanks, military aircraft, and command-and-control systems.

Advocates of increased secrecy contend that our relative position will be further eroded if we continue to give away the results of our research and development efforts. At the very least, they argue, we should delay for a few years the dissemination of information directly applicable to production processes.

While the case for restricting the outflow of technical and scientific information is relatively straightforward, counterarguments are rather involved and diverse. The first directly challenges the argument that national security is enhanced by increased secrecy. Virtually all methods for inhibiting the international flow of scientific and technical information require restrictions on its domestic circulation. For example, there is no practical way of keeping an article published in an American journal from reaching potential rivals overseas. Ideas to be kept from crossing the ocean must also be kept out of general-circulation publications, and hence would not be accessible to most Americans.

Such a restrictive policy would result in the duplication of scientific research and interfere with the interactive process vital to advances in science and engineering. Our large technological lead was built without significant information barriers, and no *increase* in the outflow of technical know-how appears to account for the recent reduction of that lead.

Requiring clearance before a paper can be presented at a meeting or published can only discourage people from working in fields covered by such regulations. This is particularly true at universities, where publication is important and researchers are free to choose the problems they tackle.

Expanded secrecy and free enterprise also conflict, as evidenced by the government's move to suppress commercialization of the voice scrambler developed by the Seattle inventors. And broadening constraints on the transfer of technical information by foreign nationals has obvious negative implications for international trade.

Openness has always been a leading attribute of American society; we take for granted the lack of censorship on what may be said or printed, even though these traditions have sometimes been violated. New barriers to scientific communication—especially prior restraint on publication and speech—not only raise questions about First Amendment rights but detract from the example of openness that America sets for the world. Such barriers would also damage

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Of Bubbles, Bombs, and Batteries: Secrecy Snafus

MAGNETIC bubble devices are computer memory elements now beginning to find use in commercial equipment. They offer a good combination of speed and price—but are not considered unusually important scientifically, and there seems little reason to view bubble memory as having great military significance.

In February 1980, the American Vacuum Society (AVS) held a small international meeting on bubble memory in Santa Barbara. Five working days before the meeting, the Commerce Department informed AVS that the conference was covered by export regulations and that "oral exchanges of information in the U.S. with foreign nationals constitute export of technical data." Such export would require a license when the destination was Eastern Europe. Failure to comply would subject conference organizers to large fines and imprisonment for up to 10 years. Foreign attendees would be required to provide written assurance that data would not be passed on to Eastern Europe.

The State Department quickly became involved and, at its suggestion, AVS rescinded its invitations to Poles, Hungarians, and Russians. The Commerce and State Departments conflicted as to whether three Chinese scientists who arrived during the controversy should be excluded.

After the approximately 30 foreign participants signed agreements not to "re-export" what they learned to any of 18 nations (including China), the meeting began. And on opening day, the Commerce Department finally agreed to allow the Chinese to attend, provided they signed the agreement with China deleted from the list. A government official later explained that such restrictive regulations are not intended to interfere with the exchange of basic scientific information, but only to block the outflow of "information that will enable somebody to build something."

That same month a much larger meeting in San Diego caused problems. Sponsored by the Optical Society of America and the Institute for Electrical and Electronics Engineers, its title was "Conference on Lasers and Electro-Optical Systems and the Topical Meeting on Inertial Confinement Fusion." Here the State Department intervened, notifying the organizers that eight Russians would be denied visas, including one member of the program subcommittee. A Russian postdoctoral researcher at the University of Texas, coauthor of a paper to be presented, was also denied permission to attend. (No restrictions were placed on the more than 300 scientists from other nations.)

The State Department explained that much equipment was to be exhibited at the meeting, and that prohibiting Russian participation was a reaction to the Soviet invasion of Afghanistan. However, inertial-confinement fusion is probably the area in which the U.S. has benefited most from its longstanding scientific cooperation with the Soviet Union.

Secrecy and the Atom

In 1976, L.I. Rudakov, a prominent Soviet physicist, toured the U.S. to lecture on his work in electron-beam fusion. This research has important application in controlled thermonuclear fusion for energy production but also indirectly relates to hydrogen bombs. After each lecture, facility officials were notified by the Energy Research and De-

velopment Administration (now Department of Energy) that the subject was classified and the ideas presented should not be disseminated. Since the reasons for classifying material are themselves secret, there has been no explanation of why the U.S. government would want to classify work that the Soviets themselves are willing to report.

Perhaps an even more significant incident occurred in 1979, involving not a scientist's work but a journalist's article written for a monthly political magazine based in Madison, Wis. *The Progressive* was ready to publish Howard Morland's article "The H-Bomb Secret: How We Got It, Why We're Telling It." When DOE officials read a preliminary copy of the manuscript in early March, the agency declared that it contained "restricted data" and asked the magazine to revise it. The editor refused and DOE obtained a temporary restraining order from a U.S. district court in Wisconsin. Several weeks later, following a closed-court hearing, the same judge issued a preliminary injunction against publication. This was appealed to a circuit court, and hearings were held that September.

The article provoking this commotion was based on material that Morland assembled from the open literature, including declassified government documents; the government never claimed that any of this information had been obtained illegally. The basis for the injunction was that the information was presented in a manner that would help other nations construct hydrogen bombs. This was the first time in American history that prior restraint was exercised against a publication on grounds of national security—with the sole exception of the 1971 Pentagon Papers, and the Supreme Court dissolved that order within a few days.

The Progressive case ended abruptly prior to completion of the appeal process when a Madison newspaper published a similar article. The Justice Department announced that this rendered the case moot.

An interesting sidelight was the way the government used its power to classify or declassify information to hamper *The Progressive* in its legal battle and to manipulate what information was released to the media. For example, security restrictions made it difficult for the magazine to gather evidence supporting its contention that the article would not significantly increase the knowledge of anyone already capable of using the information. And when the magazine did obtain supporting affidavits from experts with access to secret information, their statements were promptly classified.

When several Argonne National Laboratory scientists wrote to Senator John Glenn about the misuse of DOE's security classification procedures, their letter was classified. On the other hand, testimony supporting the government's case was made public, even though it violated security regulations by commenting on the accuracy of the Morland article. Subsequently, Livermore Laboratory physicist Hugh DeWitt, who provided an affidavit supporting the magazine, was accused by DOE of violating security procedures. DeWitt fought back with support from his congressman, several scientific societies, and his union. All charges were eventually dropped.

Cloaked Creativity

Secrecy orders on inventions—which block the granting of patents and prohibit the inventor from disclosing the invention to anyone else—are issued by the commissioner of patents and trademarks. In fiscal 1979, about 5 percent of the over 100,000 patent applications were routed by the Patent Office for review by defense agencies. This resulted in 243 secrecy orders, about 40 of which pertained to nonclassified work. In addition, about 3,300 existing orders were renewed.

Most secrecy orders cover inventions developed by government agencies or contractors working on military-related matters and protect devices obviously connected with national security, such as missile-control apparatus. But military agencies have also requested secrecy in other cases. For example, in 1980 Rohm and Hass tried to patent an improved electrochemical battery, but a secrecy order was issued at the behest of the U.S. Army. The research had been carried out for commercial purposes with company funds, but activity stopped for about six months until government officials were persuaded to rescind the order.—*S.H.U.* □

Virtually all methods for inhibiting the international flow of scientific and technical information require restrictions on its domestic circulation.

one of the few strands of international cooperation—that which links scientists and engineers across national boundaries.

Rules and Regulations

The International Traffic in Arms Regulations (ITAR) were developed as part of the Mutual Security Act of 1954, largely superceded by the Arms Export Control Act of 1976. Administered by the State Department, ITAR regulates the export of military hardware. "Technical data" are defined to include unclassified information useful in "the design, production, manufacture, repair, overhaul, processing, engineering, development, operation, maintenance or reconstruction of . . . implements of war on the U.S. Munitions List," or "any technology that advances the state-of-the-art or establishes a new art in any area of significant military applicability." The U.S. Munitions List is over seven pages long, including all the obvious items such as automatic weapons, torpedos, and missile guidance systems. It also includes electronic equipment for space flight, aerial cameras, energy conversion devices designed or modified for military equipment, speech scramblers, "privacy devices," computers, and communications equipment designed for military use.

This broad definition leads to problems. For example, a new development in metallurgy could easily be considered applicable to the development of military armor plate. A conference presentation detailing a new technique for improving signal detection in the presence of noise would be covered as relevant to the design of military radar systems. And since ITAR puts the burden for obtaining government approval "on the person or company seeking publication," one could reasonably say that a substantial portion of the engineering and scientific community has long been violating the law and is subject to criminal penalties: up to two years in prison and a $25,000 fine for each violation. Defense Department official Larry Sumney recently said that "the ITAR, if enforced to the letter, would cover virtually everything done in the United States. But people understand they are written very generally." He added that they will not be capriciously enforced, and no prosecutions have yet occurred for the publication of scientific or technical articles.

A 1978 Justice Department memorandum to presidential science advisor Frank Press (signed by Assistant Attorney General John M. Harmon) concluded that "the existing provisions of ITAR are unconstitutional insofar as they establish a prior restraint in disclosure of cryptographic ideas and information developed by scientists and mathematicians in the private sector." It also indicated uncertainty as to the adequacy of the legislative authority for the technical data provisions of ITAR.

In December 1980, the government proposed a revision of ITAR that narrows somewhat the definition of technical data (the part about advancing the state-of-the-art was deleted) and weakens, perhaps effectively eliminating, the requirement on obtaining clearance prior to domestic publication. However, the revision does not appear to ease restraints on presentations at technical meetings or other contacts with foreign nationals.

Still More Regulations

The Department of Commerce, under authority of the Export Administration Act of 1979, administers the Export Administration Regulations (EAR), which include a section on technical data. The EAR definition of technical data, a bit narrower than the ITAR definition, applies only to "design, manufacture, utilization, or reconstruction." But it also is broader in that it applies to all "articles and materials" rather than just weapons-related items. Those items on the Commodity Control List may not be exported to certain nations without first obtaining special export licenses.

However, a general license exempts data "generally available to the public in any form." This includes items that can be purchased at nominal cost, information available in public libraries, or knowledge released at open conferences. The regulations are designed to control the outflow of manufacturing details without unduly impeding commerce.

A group of government agencies, led by the Department of Defense, is now compiling a "Military Critical Technologies List" (MCTL), as mandated by the 1979 Export Administration Act. The goal is to identify the technological elements essential to an advanced military capability, and MCTL will be used to revise the Commodity Control List. The kind of basic scientific knowledge developed in universities will be excluded, but there is a considerable grey area between what might be considered industrial know-how and what is advanced engineering research. This is particulary true in microelectronics, where there is great overlap between research at universities and in industry.

Such barriers would also damage one of the few strands of international cooperation: that which links scientists and engineers across national boundaries.

Since 1917 the government has been legally able to order that inventions be kept secret on grounds of national security. This restriction originally applied only during wartime. Later legislation removed this restriction but required that such orders be reviewed annually unless the president has declared a national emergency, in which case the orders remain in effect until six months after the emergency ends. (The emergency proclaimed by President Truman in December 1950, during the Korean War, lasted for 28 years.)

Secrecy orders are issued by the commissioner of patents and trademarks when the head of a defense agency issues an opinion that disclosure "would be detrimental to the national security." No such order has ever been subjected to judicial review, nor has there ever been a judicial test on First Amendment grounds.

Secrecy orders may be issued even if the Patent Office does not consider the invention patentable or if the patent application is withdrawn. Inventors may appeal to the secretary of commerce after petitions to the sponsoring defense agency have been denied. The inventors are entitled to seek compensation for damages, but this right has rarely been exercised successfully. Only 29 claims were filed between 1945 and 1980 (about one per thousand orders): 9 have been settled, 10 denied, and the rest are still pending. Litigation is generally quite lengthy: in 1977, General Electric finally won a suit concerning a World War II radar invention.

Special secrecy rules apply to atomic energy and are administered by the Department of Energy (DOE). Authorization stems from the Atomic Energy Act (the latest version was passed in 1954), intended to protect American security in the nuclear area, inhibit the international proliferation of nuclear weapons, and promote the use of atomic energy for peaceful purposes. Clearly, a delicate balance must be achieved.

For example, many areas of knowledge are applicable to both weaponry and nonmilitary purposes. Technology for producing fissionable materials could be used in operating nuclear reactors or building atomic bombs, and DOE can declare secret any information it considers "relevant to national security matters." Of course, the growth of the nuclear energy industry worldwide has greatly enhanced the amount of openly available information.

Another secrecy-related problem pertains to the source of knowledge. Any person making an invention or discovery in the field of atomic energy must file a report with DOE within six months, unless a patent application has been filed. The DOE may rule that the invention contains restricted data, thus acquiring control over its dissemination. If a patent application is filed, the Patent Office must notify DOE, which may then request a secrecy order.

Secrecy Solutions

An outgrowth of the cryptography controversy was the formation in 1980 of the "Public Cryptography Study Group" (PCSG), assembled by the American Council on Education and funded by NSF. The nine-member group included mathematicians and computer scientists nominated by various professional societies, some university administrators, and the general counsel of NSA. The group's goal was to satisfy NSA's concerns about the publication of cryptography research without unduly hampering such research or impairing First Amendment rights.

The PCSG first considered a mandatory system, backed by NSA, that would require all papers dealing with cryptography (as defined by NSA) to be submitted to NSA for prepublication censorship. The burden of proof would be on the government, judicial review would be provided by a special court acting under "suitable security precautions," and compensation would be provided for economic losses resulting from the constraints.

This proposal was rejected, partly because the group felt it had not been able to assess the need for secrecy. (NSA said it could not present its case fully unless the group applied for security clearance, which it did not do.) Another reason was the negative impact the NSA proposal might have on cryptography, harming individual and commercial privacy as well as foreign trade. The PCSG was also unable to define what should be kept secret with sufficient precision to satisfy what it regarded as constitutional requirements. Finally, the group felt that a compulsory system would not be as practical as a voluntary system, which would more likely gain cooperation from researchers.

The PCSG eventually recommended that a system be established, on a trial basis, in which NSA would invite authors to submit cryptography manuscripts for prior review. NSA would determine the areas to be covered in consultation with appropriate technical societies, excluding fields such as "general mathemat-

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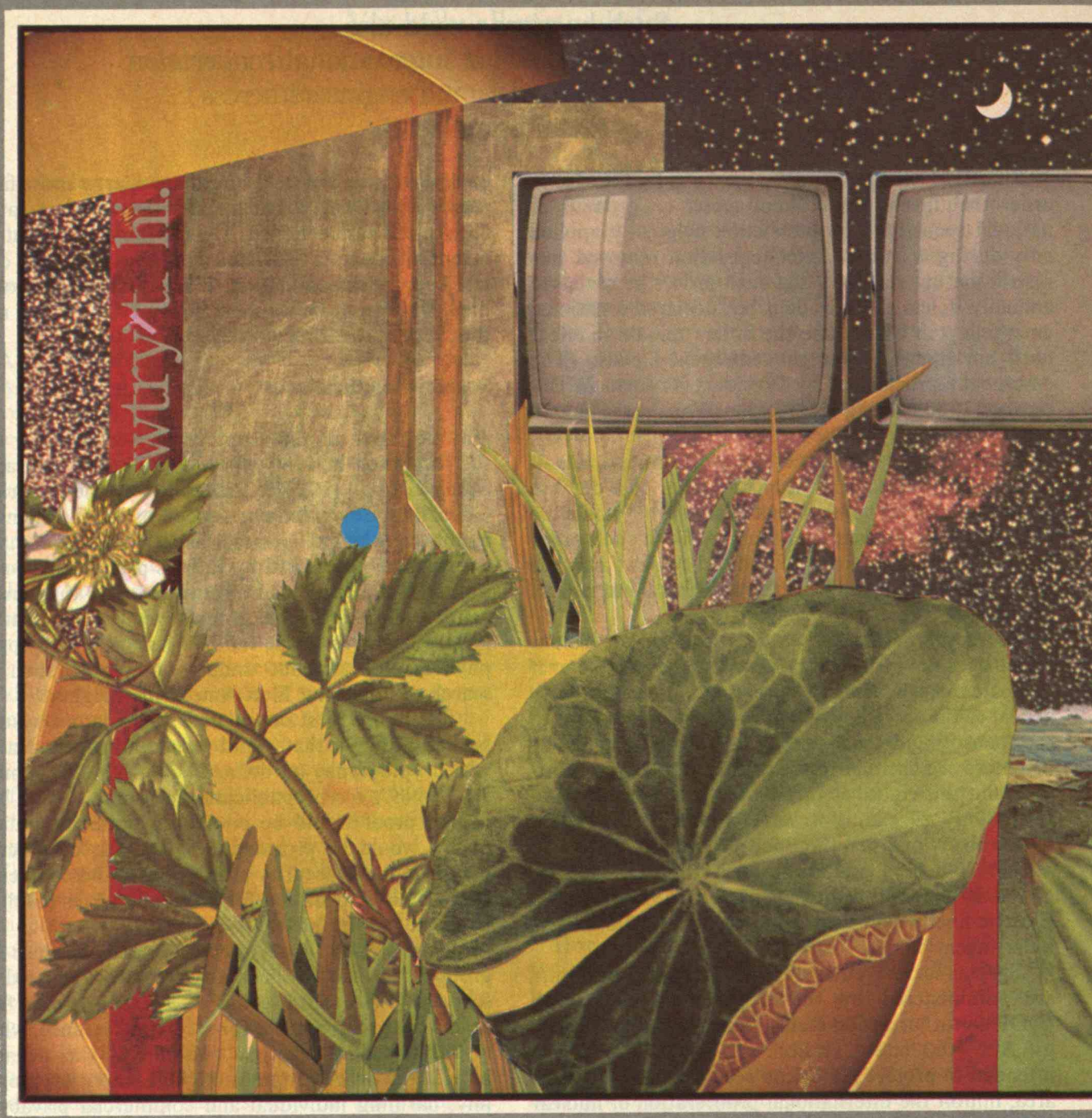

KAREN WATSON

The Screen Revolution

by Miles Orvell

McLuhan's vision of a utopian "global village" unified through media was never realized. New communication technologies could help us realize this dream or further alienate us.

FOR the past 150 years, technology has promised us utopia. And despite our nagging sense that the universal good life hasn't quite arrived, we in the West—and especially America still tend to greet every major invention with unquestioning anticipation. The steam engine, the automobile, the airplane, electricity, nuclear energy, the computer, now robots—what have they not promised us in the way of personal and collective salvation? Humans still extend their dominion over nature, work will be effortless, wealth, knowledge, and opportunity diffused among all persons.

Communications technologies have been a key part of this promise: radio, the phonograph, film, the telephone, television, and more recently satellite communications, video cassettes, cable television, and the home computer—all have been hailed as breakthroughs, capable of transforming and regenerating society. Who would not want to believe what the first issue of *Radio Broadcast*, in 1922 predicted as the inevitable political effects of the new technology: that the airwaves would be the means for mass diffusion of education, that "government will be a living thing to its citizens instead of an abstract and unseen force,"

and that "elected representatives will not be able to evade their responsibility to those constituents who put them in office"? And who would not want to believe, 60 years later, the replay of these utopian claims for the new communications technologies?

This is not to say that the more things change the more they stay the same. Things don't stay the same, and we seem today to be on the verge of a wave of changes brought about by the widespread application of communications technologies that were only nascent in the 1970s. But whether things will change for better or for worse, and for the benefit of just some of us or all of us, are matters of far greater complexity.

In thinking about the social, political, and personal effects of communications technologies, we must begin with the immensely influential theories of Marshall McLuhan, whose efforts at understanding the media in the 1960s and 1970s dominated popular thinking in America and helped create the climate in which the new media age has flourished. It is 15 years since the height of McLuhan's influence, but his recent death spurs the memory of how startling his formulations were, how much he seemed to promise in the name of the media.

Mention McLuhan to anyone and there's an excellent chance that person will think "the medium is the message." Not since Einstein and his T-shirt formula has an intellectual been so linked with a single phrase. McLuhan's *Understanding Media: The Extensions of Man*, published in 1964, outlined his theory of the impact of media on culture and our senses. McLuhan, like the Bible, left nothing out, surveying all the ways people have extended themselves into the world—from roads, clocks, and clothing to print, radio, and television. He followed the widely debated *Understanding Media* with variations on the same central themes that became more and more oracular. Everyone said he was a prophet and so he talked like one, uttering his truths in aphoristic style (aphorisms would *involve* the reader in the subject because they were hard to figure out) and turning the printed page into a dizzying collage of typographic pyrotechnics and visual illustrations. If print was passé, the book as physical object—remade to look like television—perhaps was not.

From Prophet to Rerun

One of McLuhan's favorite theories was that the content of each new medium was the old medium it replaced: television was about movies, which were about books; print was about talk, and so on. True to his theory, each new incarnation of McLuhan was about the previous McLuhan. A writer who was never shy about quoting his most admired sources, McLuhan began increasingly to quote himself. However, this did not detract from his celebrity: there were jokes about McLuhan, *New Yorker* cartoons about McLuhan, appearances on TV and radio in which McLuhan would play Delphic oracle to interviewers too stunned by his brillance to do anything but look stunned. And there was his final apotheosis, McLuhan playing McLuhan in Woody Allen's film *Annie Hall*, brought on as a *deus ex machina* to illuminate a movie lobby discussion of—naturally—McLuhan.

McLuhan had a sense of humor, but he also took himself and his ideas dead seriously. And he was taken seriously by some of the best critics of the 1960s, nearly all of whom wrote an essay on him. While most of the discussion was critical of one phase or another of McLuhan's thought (McLuhan insisted that these detractors simply misunderstood him), virtually all agreed the ideas were worth considering. McLuhan made Western society conscious of what had previously been invisible—the impact of communications technology on our lives. While there had indeed been theorists and students of technology and the media before McLuhan, it was McLuhan who launched the fireworks that made us look. In the 1960s his eruptive prose and shattering paradoxes were keyed to the psychedelic hour.

But during the 1960s McLuhan gradually worked his way to the motto that would virtually manacle his own mind: "The medium is the message." McLuhan's theory derives from his sense that what matters is not the content of the medium but the technique or medium itself. Thus, the shift from unique scribal manuscripts to the multiplicity and uniformity of printed books enforced an intellectual habit of linearity, logic, and sequential thinking that resulted in modern science and bureaucracy, as well as our loss of a more primal sense of harmony with a world of sounds, smells, and touch. Conversely, the shift from a print-dominated culture to one in which electric forms of communication prevail returned to humans a pattern of experience and information that was mosaic (rather than linear), simultaneous (rather than sequential), and more deeply involving of our senses of hearing and touch (rather than merely sight). Moreover, the electric media fostered a sense of community among persons and nations rather than isolation and privacy: utopia had arrived.

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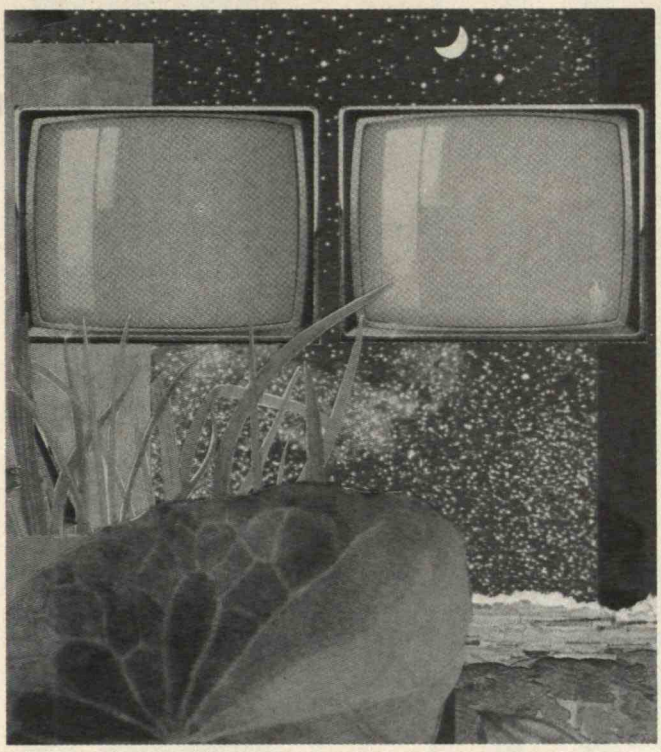


McLuhan's theories have been criticized over the years on many grounds. First, McLuhan assumed that people have a fixed ratio of the senses, and that the various media have properties that emphasize one or more of the senses at the expense of the others. Thus, print calls on our sight at the expense of our hearing, while television, which calls on both hearing and touch (the TV screen "bombards our eyes") is more involving. McLuhan claimed that "harder-edged" media—such as print—are "hotter" than the less-defined images of dots and lines on the television screen, which compel us to participate in the construction of the message and are thus "cooler." These assumptions not only rest on questionable physiological evidence but exaggerate the differences between the media.

But the main problem with McLuhan's theory is that it underestimates the degree to which *content* affects the quality of our attention: print can be, after all, more involving psychologically than the supposedly more embracing electric media. As the critic Jonathan Miller has written, "Cognitive interest determines the use to which the various human senses will be put, not vice versa." Recent students of television and popular culture generally have come to regard "content" as a cumulative concept, analyzing not single TV programs, for example, but whole genres. Viewed cumulatively, the content of the media can be of considerable importance in shaping habits of perception and response.

Equally questionable is the historical theory underlying McLuhan's assertions about technology and culture. Borrowing from the Canadian economic historian Harold Innis, McLuhan assigned an extraordinary degree of importance to the media in accounting for historical change: the invention of writing, print, radio, and television—these, he said, are the engines that have driven social, political, and economic change in world cultures. Of course, technology is of major significance in effecting change, but McLuhan's technological determinism discounts the many other factors that contribute to social change—the readiness of a culture to accept a given technology, the particular uses of inventions, legal, institutional, and economic patterns, and so on.

If Wishing Could Make It So

What finally seems to lurk behind McLuhan's theory of media and culture is the vague shadow of myth. In McLuhan's mind, electricity restored us to the garden of the senses that print cast us out of: the electric media involve us more deeply in the process of communication and events all over the world. Nevertheless, the global village McLuhan predicted still seems very remote. McLuhan had a habit of stating as matters of fact what he would only *like* to see.

Such confusion—between wish and actuality—clouds one of the key issues in McLuhan's philosophy of social change: the question of human control over technology. For while McLuhan argued that unpredictable changes in communications technology have been critical in shaping our sensory habits and social arrangements, he also maintained that, contrary to this determinism, we do control the effects of technology on our lives. By understanding the media, we become conscious of our victimization and develop strategies for intelligent survival.

"Control over change would seem to consist in moving not with it but ahead of it. Anticipation gives the power to deflect and control force," McLuhan said in *Understanding Media*. He was right if you put the matter abstractly, but such optimism can distract us from a more pragmatic view of the relationship between technology and culture. For example, we may be able to anticipate results but lack the power to alter the forces of change, and it is naive to assume that changes don't benefit some and harm others.

The main problem with McLuhan's theory is that it underestimates the degree to which content affects the quality of our attention.

When McLuhan said that with automation "the withdrawal of the present workforce from industry causes learning itself to become the principal kind of production and consumption," he was obviously skipping a step that might concern "the present workforce"—namely unemployment.

What is interesting about McLuhan's well-publicized views from the 1960s is that they are so at odds with those underlying his fine early book, *The Mechanical Bride* (1951). In that volume, a pioneering study of American industrial culture, McLuhan was as much interested in the message as in the medium, and the world McLuhan uncovered in the advertisements of the mid-twentieth century was far from utopian.

The Mechanical Bride was an anatomy of a society dominated by technology and the requirements of mass consumption. It was a society in which the communications media—advertising, entertainment, radio, newspapers—exploited our yearnings for fantasy and sexual fulfillment, offering us happiness in the form of whiskey, a Coke, a pill, hosiery, Ivory Flakes, or Lysol. To McLuhan, the America of mid-century was a culture that had adopted the values of technology as a model for the inner life and interpersonal relationships, as if technology had invaded our bodies and snatched our souls. Education could be obtained from a one-volume, mail-order curriculum, and success from *The Art of Plain Talk*. Men were Tarzan, Superman, Bogart, or John Wayne; women were cheerleaders, bodies in beds, replaceable parts.

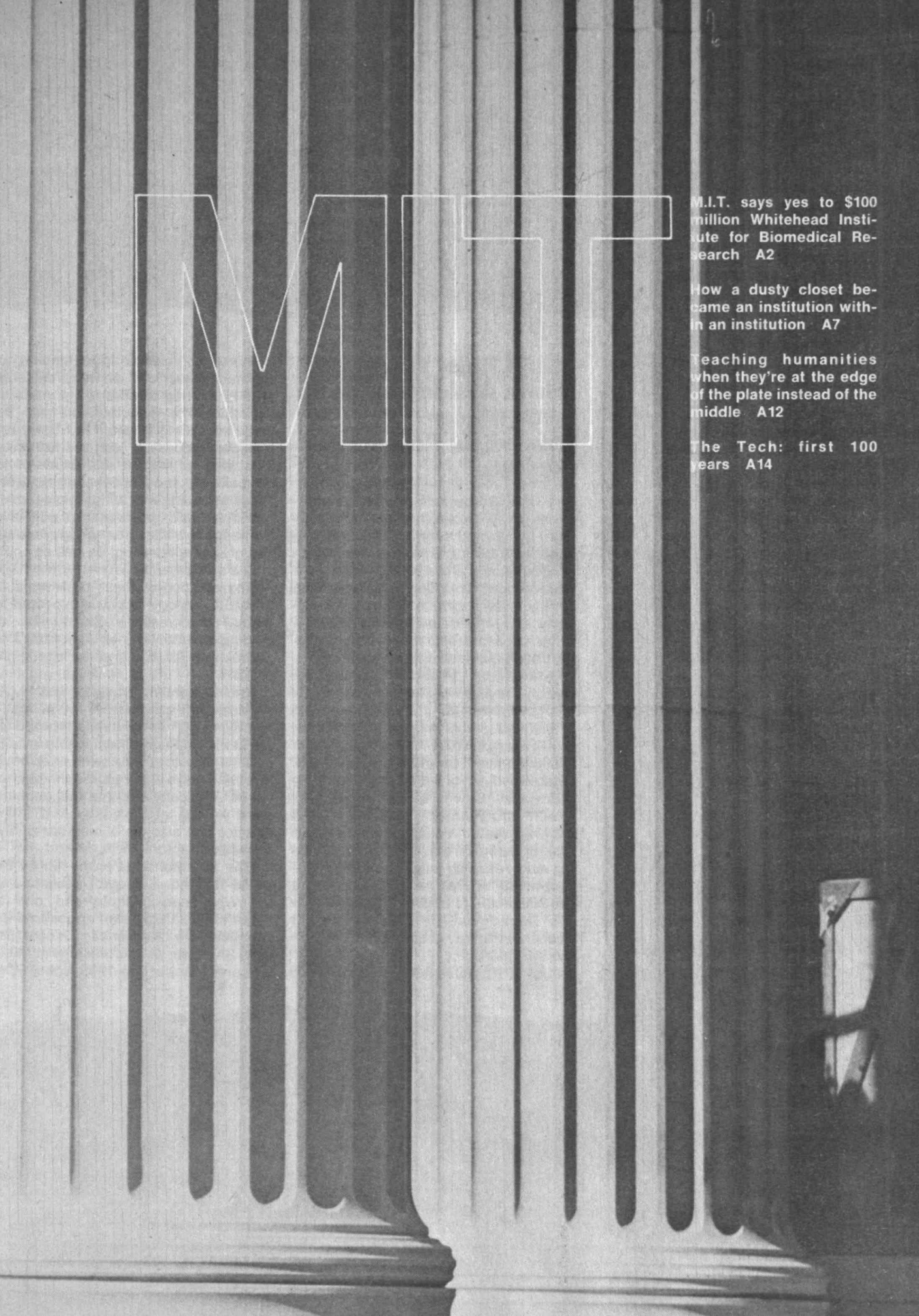
Of course, some things have changed—new products for new times, subtler styles for jaded consumers. But the mass media that McLuhan came to see as agents of global harmony are still promoting an ideology, to use McLuhan's earlier phrase, that "does violence to actuality." The old skeptical McLuhan may be a better guide to the future than the later oracle of utopia.

Tending to leap from the relatively microscopic physiological effects of the media to the extravagantly general (TV as global village), McLuhan left out the crucial middle ground of our daily lives. But during the past 15 years, scores of scientists have studied the effects of television on human behavior, trying to answer empirically questions that McLuhan tended to sidestep—the effect of television on political beliefs and voting patterns, on reading and learning, on the self-images of ethnic minorities and women in America, and on the behavior of children and teenagers, as well as its potential for inciting violence. And students of the media have continued to ponder, as they have since the late 1930s, the metaphysical implications of our communications environment—how the various media have increasingly defined "reality" for us.

But until now this empirical research and the broader cultural speculations about television's effects have been based on the assumption that the basic technology would remain more or less constant. It has also been assumed that watching television is essentially a passive activity. But a significant shift is occurring in the technology of home media and in our habits of using the set, a shift from a predominantly passive mode to a predominantly active one.

Home-Delivered Culture

Despite the earliest conjectures by Thomas Edison and others on the many uses of the new communications technologies for recording, storing, and transmitting information, only a few were widely developed and marketed, and these tended to be the passive ones. For example, for 60 years the phonograph was used less for dictation or sending messages (envisioned as primary uses by Edison) than for listening to recorded music. And the earliest advertisements for the record machine celebrate the luxuries of pas-



M.I.T. Says Yes to Edwin C. Whitehead's $100 Million Biomedical Research Institute

The M.I.T. Corporation gave its approval on Friday, December 4, to an agreement by which the newly formed Whitehead Institute for Biomedical Research would become affiliated with M.I.T. The Corporation's vote signaled acceptance by M.I.T. of a unique interrelationship between an academic institution and a private philanthropic foundation in support of research and teaching.

Under the affiliation, certain research scientists will hold joint appointments on the M.I.T. faculty and the Whitehead research staff. In addition, M.I.T. will receive a $7.5 million gift from the Whitehead Charitable Foundation, established by philanthrophist and industrialist Edwin C. Whitehead of Greenwich, Conn. M.I.T. will use the gift as an invested endowment fund and employ income from it to support teaching and research within academic departments where the joint professors are affiliated—to begin with, primarily in the Department of Biology—and, if needed, to defray costs associated with the affiliation.

Up to 13 Whitehead scientists are expected to receive appointments as assistant, associate, or full professors at M.I.T. during the first eight years of affiliation. The appointments will be made according to usual M.I.T. faculty selection processes, with the full costs associated with these appointments to be paid by the Whitehead Institute. These scientists will do their research at the Whitehead Institute, but will have full responsibilities for undergraduate and graduate teaching, as well as committee service, at M.I.T.

The addition of these professors to the M.I.T. biology faculty is expected to permit an increase in the number of graduate students enrolled in the Department of Biology over the next eight years.

The agreement provides that M.I.T. will designate candidates for 3 of the 14 members of the Whitehead board of directors. The agreement also provides that the director of the Whitehead Institute will always be a tenured member of the M.I.T. faculty and that this appointment will be approved by M.I.T. The director will also be a member of the board of directors.

The affiliation was proposed by Dr. David Baltimore, director-designate of the Whitehead Institute and one of those who will hold joint appointments. Dr. Baltimore is American Cancer Society Professor of Microbiology at M.I.T. an corecipient of the 1975 Nobel Prize

in Physiology or Medicine for his work in molecular genetics. He urged the M.I.T. affiliation because, he said, the quality and effectiveness of research at the emerging Whitehead Institute would be improved if a way could be found to involve scientists there in teaching. Intermingling of teaching and research, in which each reinforces the other, he said, is a characteristic that has traditionally made American science strong.

An Overwhelming Faculty Endorsement

Announcement of the action by the M.I.T. Corporation at its regular quarterly meeting was made by Howard W. Johnson, chairman of the Corporation. Mr. Johnson said the Corporation's executive committee had endorsed the affiliation earlier, as had the Corporation's Department of Biology Visiting Committee chaired by Corporation member David R. Clare, president of Johnson & Johnson, Inc., New Brunswick, N.J., and a 1945 graduate of M.I.T.

The formal affiliation was recommended to the Corporation by President Paul E. Gray and Provost Francis E. Low.

The M.I.T. faculty at its monthly meeting last November 18 also endorsed the affiliation by a vote estimated at five-to-one or more. The meeting was attended by about 350 of M.I.T.'s 1,000 faculty members, which culminated several months of faculty discussion and debate (*see page A4*).

In announcing their decision to recommend the affiliation, President Gray and Provost Low told the faculty that lengthy discussions of the proposal over the past several months had strengthened the affiliation because of the questions raised.

"As the relationship between the Whitehead Institute and M.I.T. develops, we will continue to be attentive to the concerns which have been raised over these last several months," they said.

The Corporation also expressed appreciation to the faculty for their contributions to the discussion and decision on the affiliation question and "acknowledged the concerns voiced by members of the faculty." Mr. Johnson described the Corporation's decision as an innovative step in the support of basic science in the U.S., and he expressed his confidence that the affiliation will be carried out in a manner which will benefit the field of developmental biology.

M.I.T. has already designated the three who will represent the university on the Whitehead board. They are former President Jerome B. Wiesner, Dean Abraham J. Siegel of the Sloan School of Management, and Dr. W. Gerald Aus-

ten, '51, chief of surgical services at Massachusetts General Hospital. Dr. Austen and Dr. Wiesner are members of the M.I.T. Corporation.

Mr. Whitehead, founder of the Technicon Corp., now a part of Revlon, Inc., is not himself a member of the Whitehead board of directors. The present eight members include the chairman, John Sawhill, former president of New York University; Mr. Whitehead's two sons, John Whitehead, an executive with Technicon, and Peter, an architect, and Mr. Whitehead's daughter, Susan Whitehead, a law student; Herman Sokol, president of Bristol-Myers Co., Inc., and a former Technicon director; Leonard Skeggs, professor of biochemistry at Case Western University and the inventor of the Technicon Auto Analyzer; Dr. Lewis Thomas, chancellor of the Memorial Sloan-Kettering Cancer Center; and Dr. Baltimore.

There will be three additional positions on the Whitehead board to be chosen with the concurrence of both M.I.T. and the Whitehead Institute. Dr. Donald S. Frederickson, former director of the National Institutes of Health, and Bernard J. O'Keefe, chairman of EG&G, Inc., Wellesley, Mass., have accepted invitations to hold two of these positions.

A $20-Million Biomedical Laboratory

Mr. Whitehead formed the nonprofit Whitehead Institute for Biomedical Research to pursue independent basic research in developmental biology. His financial resources, he said, had been derived through the development of medical technology and he felt an obligation to use his resources to contribute to basic scientific knowledge.

Mr. Whitehead has agreed to provide the Whitehead Institute with a $20-million research facility located near M.I.T. and additional funds to equip the building, which will have 130,00 square feet of laboratory and office space.

Mr. Whitehead also has established a $60-million trust fund which will provide $5-million annually to the Whitehead Institute for operating expenses and for an endowment fund.

Finally, Mr. Whitehead has provided that upon his death he will bequeath to the Whitehead Institute an endowment of $100 million, less payments yet to be made from the trust fund.

Dr. Baltimore has begun to assemble an administrative staff for the Whitehead Institute. In addition, two present members of the M.I.T. biology faculty—Professors Robert Weinberg and Harvey Lodish—have agreed to join the Whitehead Institute research staff. Under terms of the affiliation with M.I.T. they will retain their M.I.T. faculty appointments.—*Robert M. Byers*

After a Debate That Seemed Contentious, a Strong Show of Faculty "Cohesiveness"

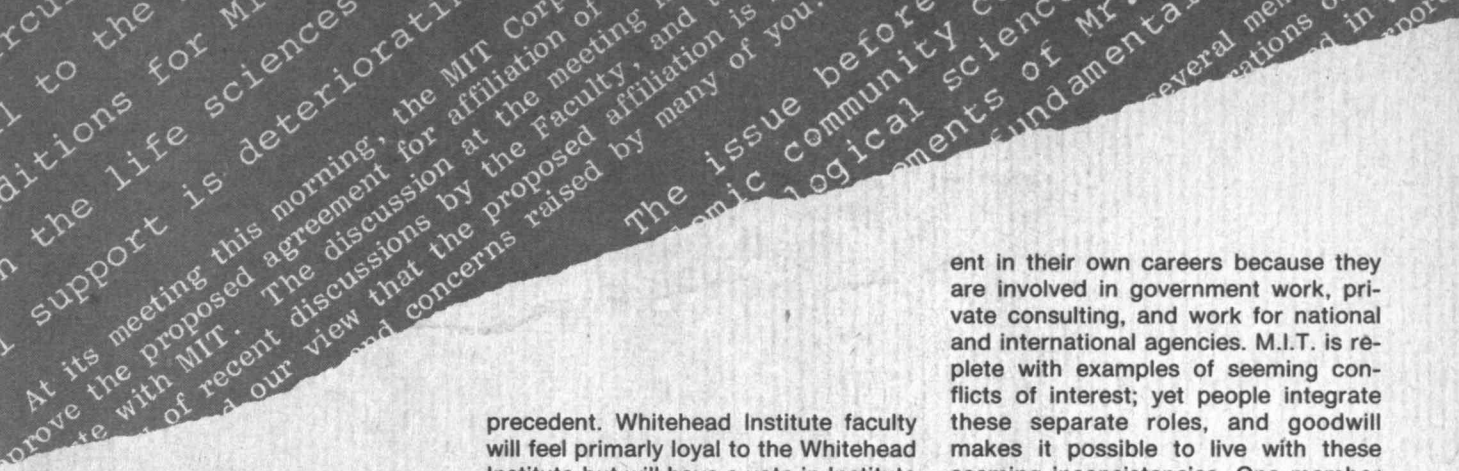
The faculty meeting in Room 10-250 was charged with enormous energy—seats filled quickly, visitors crammed into their section, and even the stairs were packed with members and spectators. Latecomers climbed over occupied seats to grab the last few. The din of voices was loud; indeed, the atmosphere of anticipation was more like that for a long-awaited celebrity appearance than a faculty meeting.

It was the culmination of several months of faculty discussion and debate over the proposed affiliation of the Whitehead Institute for Biomedical Research with M.I.T. and some 350 of M.I.T.'s 1,000 faculty members—a near-record—were present.

Concerned faculty members had already sent their views to their colleagues—some fearing the unusual implications of the agreement for M.I.T.'s autonomy, some anticipating the opportunities which the affiliation would offer to both institutions. At the meeting these views were repeated and then discussed. Among the highlights:

☐ *President Paul E. Gray, '54*: Money is not the reason; the affiliation should stand on its own merits, worth doing without money. . . . I think our relationship will be convivial and congenial, and the Whitehead Institute will produce an activity appropriate to this academic community.

There is a termination agreement: in eight years, either party can terminate (with two years' notice) with no fault. If



the Whitehead Institute chooses to terminate, the salaries of joint faculty members who stay at M.I.T. would be borne by the Whitehead Institute. If M.I.T. chooses to terminate, the salaries of ten joint faculty members become our responsibility. Three out of five members of the Whitehead Institute Finance Committee (responsible to the board of directors of the Whitehead Institute) are to be children of the founder, Edwin C. Whitehead. I told him it would look better *not* to have his children on the board, but he wants his family to be associated with the Institute; it is important to him.

M.I.T. has broken new ground in the past. Examples: the establishment of Lincoln Laboratory, the interdepartmental research laboratories, the Industrial Liaison Program. While the proposed affiliation is novel, it is consonant with our central purposes. Our posture a century from now requires maintenance of our credibility and independence. But we need new knowledge to adapt M.I.T. to a changing environment. The risk of *not* going forward is for M.I.T. a serious one.

☐ Professor Ascher H. Shapiro, '38 (mechanical engineering): The issue is not the desirability of biomedical research, or lack of confidence in Professor David Baltimore, the director-designate of the Whitehead Institute, or the good intent of Edwin Whitehead himself. What is proposed is an unnatural marriage—with potential conflicts of partners not sure of each other, even the contemplation of divorce arrangements.

It is not appropriate for M.I.T. to relinquish control over its finances, research and educational programs, and selection of its faculty. The public will see the Whitehead Institute as part of M.I.T.—but in fact it will operate independently from M.I.T. Giving M.I.T.'s name to an independent institution is an extraordinary and perhaps dangerous precedent. Whitehead Institute faculty will feel primarly loyal to the Whitehead Institute but will have a vote in Institute affairs. Its director will have primary responsibilities to Whitehead Institute yet will participate here. The danger of conflict of interest is substantial. M.I.T.'s 1,000 faculty are not for purchase.

☐ *Professor Louis D. Smullin, S.M.'39* (electrical engineering): We're talking about *change*. Many of the fears that are expressed today were also expressed when Lincoln Laboratory was added in the 1960s. I submit that those fears have not been justified. Like any institution, the Whitehead Institute will work if we want it to.

☐ *Professor Willam F. Busby, Jr.* (nutrition and food science): We can choose expansion and growth, or we can turn it away, because of limited risk. There is such a thing as irresponsible trust, but there is also such a thing as irresponsible mistrust.

☐ *Professor Jerome Y. Lettvin* (electrical engineering): I don't see it as a marriage; I see the agreement as a liaison between consenting institutions. After 30-odd years here I have come to conclude that if something is to fail, by and large it does. Though my apprehensions are not tremendously calmed by the current statements, I am not disposed to stop anyone from doing research with whatever funds can be obtained. Academics tend to attribute more morality to themselves in faculty meetings than they probably have.

☐ *Professor Baltimore:* There is excitement and opportunity in Mr. Whitehead's offer to put his great fortune to work in the interest of science. The Whitehead Institute will operate on the principles of academic freedom. The discussions about the affiliation have moved people together and have increased trust. Those who have been in favor of W.I., those who have been opposed, and those who have been indifferent—I know all will join me in making W.I. as great as it can be.

Conflicts of Interest

Others in favor of affiliation presented descriptions of conflicts of loyalty inherent in their own careers because they are involved in government work, private consulting, and work for national and international agencies. M.I.T. is replete with examples of seeming conflicts of interest; yet people integrate these separate roles, and goodwill makes it possible to live with these seeming inconsistencies. One member observed that the W.I. arrangement might in fact constrain research less than do the priorities created by government decisions about research directions.

A Biology Department member opposed to the affiliation pointed out that, under normal sponsored research arrangements, faculty members are free to apply or not to apply for funds; and he urged his colleagues to consider carefully how they would feel if their departments had to give up power to select appointments or research areas.

"Overwhelming Approval"

Finally, there were two votes, one on a negative resolution presented by Professor Shapiro and one on the subsequent motion of Professor Charles E. Holt III, Ph.D.'62 (biology): "Recognizing the great potential value of the proposed Whitehead Institute to research and education at M.I.T., we support the administration's plan to bring the Whitehead proposal to the Corporation. At the same time we acknowledge the existence of legitimate, deep concern over the risks inherent in the venture, and hope that efforts to minimize these risks will continue."

The results were "unambiguous," writes Professor Jack P. Ruina, secretary, in the faculty minutes—a "clear defeat" for the Shapiro resolution, "overwhelming" approval for Professor Holt's alternative. Indeed, writes Professor Ruina, the meeting represented "a clear demonstration of faculty cohesiveness, of satisfaction with the debate about the W.I. affiliation, and of goodwill of the faculty for M.I.T."—*M.L.*

What the Faculty Said About Whitehead

Some excerpts from the written opinions circulated by their colleagues to members of the faculty during the week prior to the faculty's final debate about the Whitehead affiliation:

☐ *Professor Sheldon Penman* (biology): "We are being asked, as faculty, to approve the appointment of 20 bona-fide faculty members who will be under the control of, and responsible to, an outside board of directors. We do not know the powers of this board nor how its chairman is to be selected. We do know, however, that the finance committee of the board must be controlled by Mr. Whitehead's children and this committee can exercise veto power over many, if not all, financial decisions. . . . We learn from the *Boston Globe* that the funds for the Whitehead Institute will be derived from stock held exclusively in the Revlon Corp. It would appear that the continuity of funding is dependent upon the fortunes of one company. We also know that the funding is completely dependent on the continuing tax deductibility of payments to the Whitehead Institute. Should the tax laws change or the Whitehead Institute cease to qualify for tax deduction the funding will disappear. . . . It is also clearly stated that the areas of research in which new faculty are to be hired are to be determined entirely by the Whitehead Institute. Needless to say, this raises serious problems for the Biology Department with respect to its teaching responsibilities.

☐ *Professor Gene M. Brown* (biology) *and 23 faculty colleagues from seven departments in the Schools of Engineering and of Science:* We believe that the affiliation between M.I.T. and the Whitehead Institute . . . would be greatly beneficial to the progress of biological sciences at M.I.T. It would create conditions for M.I.T. to continue its national and international leadership in the life sciences at a time when expansion is needed and financial support is deteriorating. We also feel that any of the potential sources of friction arising from hypothetical divided loyalties will be minimized by the exercise of the traditional M.I.T. spirit of mutual trust and cooperation, a spirit that we are confident will equally be present in the Whitehead Institute under the leadership of Professor David Baltimore.

☐ *Professors Anthony P. French* (physics), *John M. Buchanan* (biology), *and 31 colleagues from the Schools of Science, Engineering, Management, and Humanities:* The Whitehead Institute is envisaged as a major vehicle for biological research involving M.I.T. faculty and graduate students, but the control of its programs and finances is to be under a directorate in which M.I.T. would have only a minority voice. . . . A central feature of the arrangement would be the creation of a number of positions for new faculty members. The initiative for their appointments (and their complete financial support) would with few if any exceptions come, not from M.I.T., but from the management of the Whitehead Institute, primarily on the basis of their potential value to the research programs of that organization. . . . We believe that such a close tie, with its implications for our educational programs and academic independence, would be contrary to the best interests and academic integrity of M.I.T. A century from now M.I.T. will still occupy a first-rank position in technology, science, and human affairs only if it is able to maintain its independence and credibility as an educational institution. . . M.I.T. should resolve that . . . links with satellite organizations should occur only when the responsibility of all parts of M.I.T. remains firmly in its own hands.

Warren Seamans and the M.I.T. Museum: How a Dusty Closet Became an "Institution Within an Institution" in 10 Years

It all began when Warren A. Seamans, who was then administrative officer in the Department of Humanities, was asked to look for something—anything—historical to be exhibited for the inauguration of Jerome B. Wiesner in 1971. So he did what anyone would do with a problem like that: ask Elmer Condon, a long-time member of the physical plant staff with a photographic memory for what was where.

"Oh yeah," Elmer said, and off they went to a dusty room in a warehouse building half way from M.I.T. to Central Square. Mr. Seamans' memory is vivid—"poking through piles of paintings

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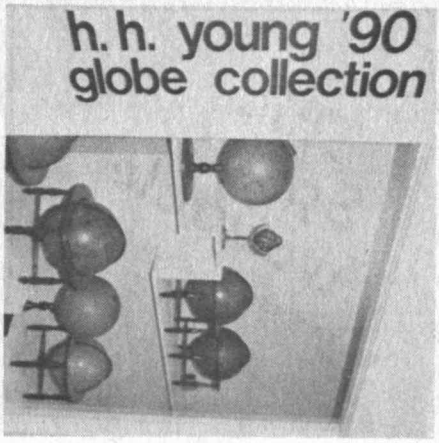
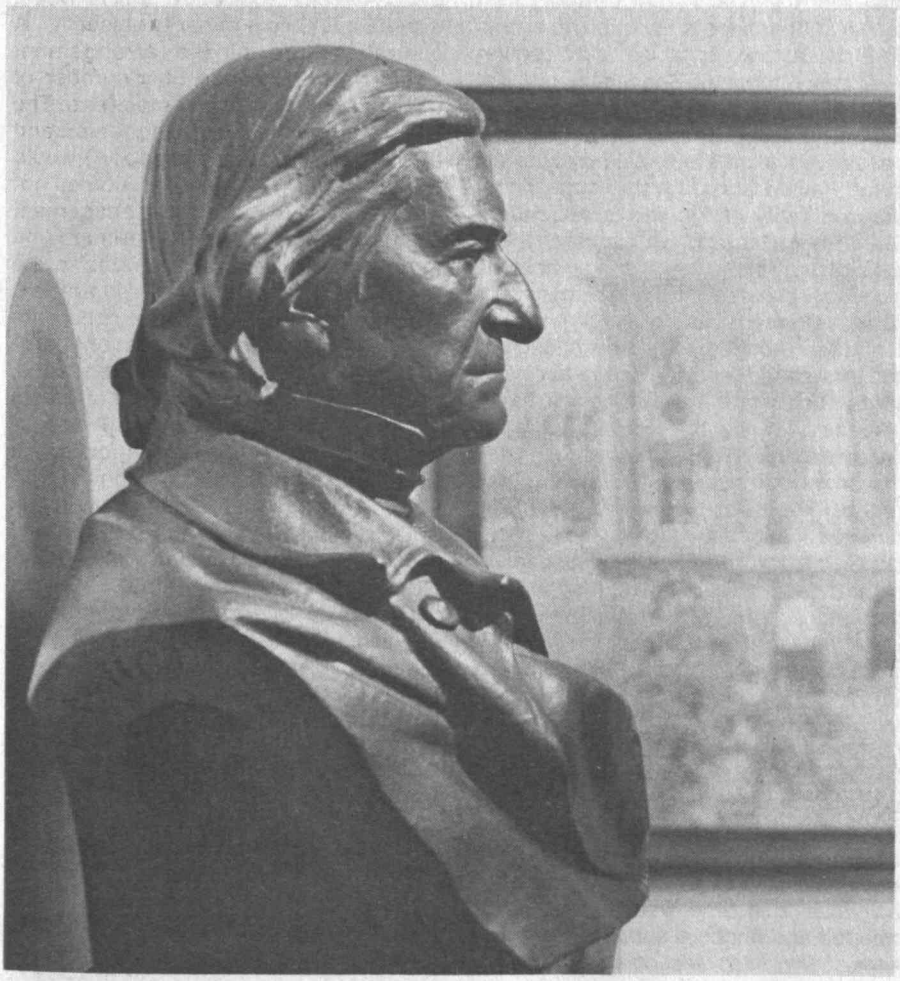
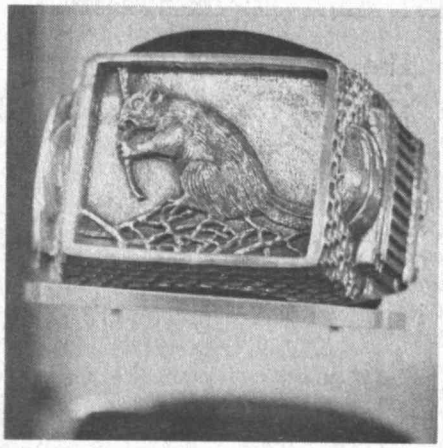
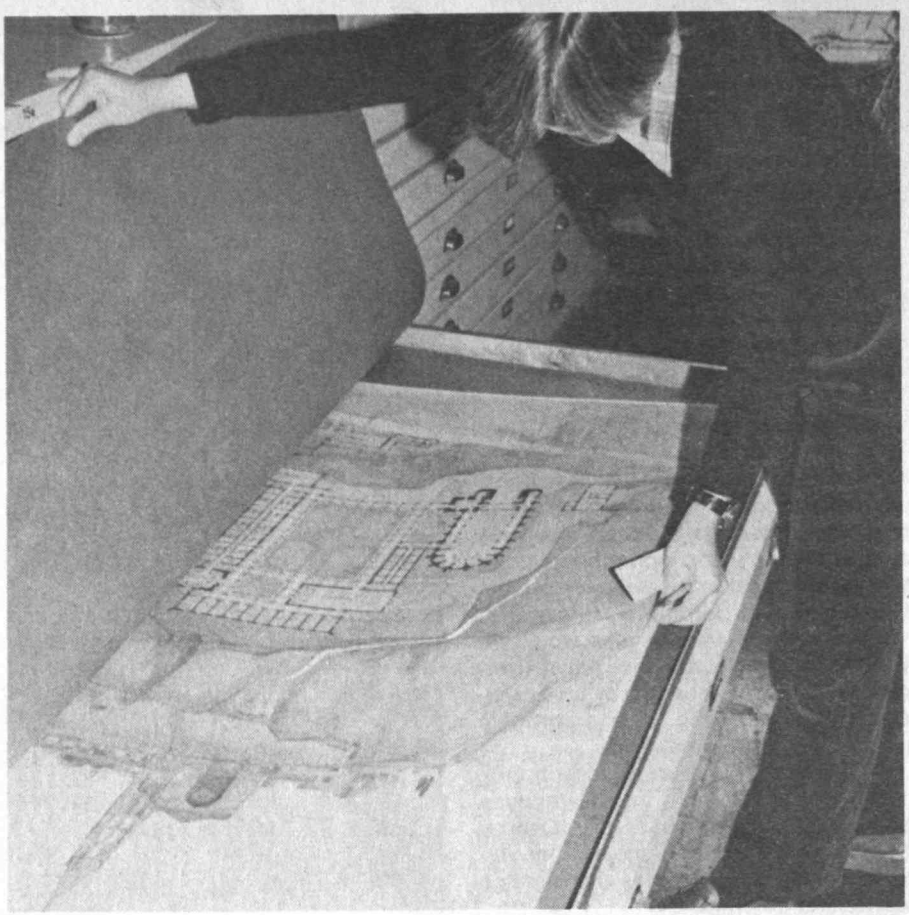


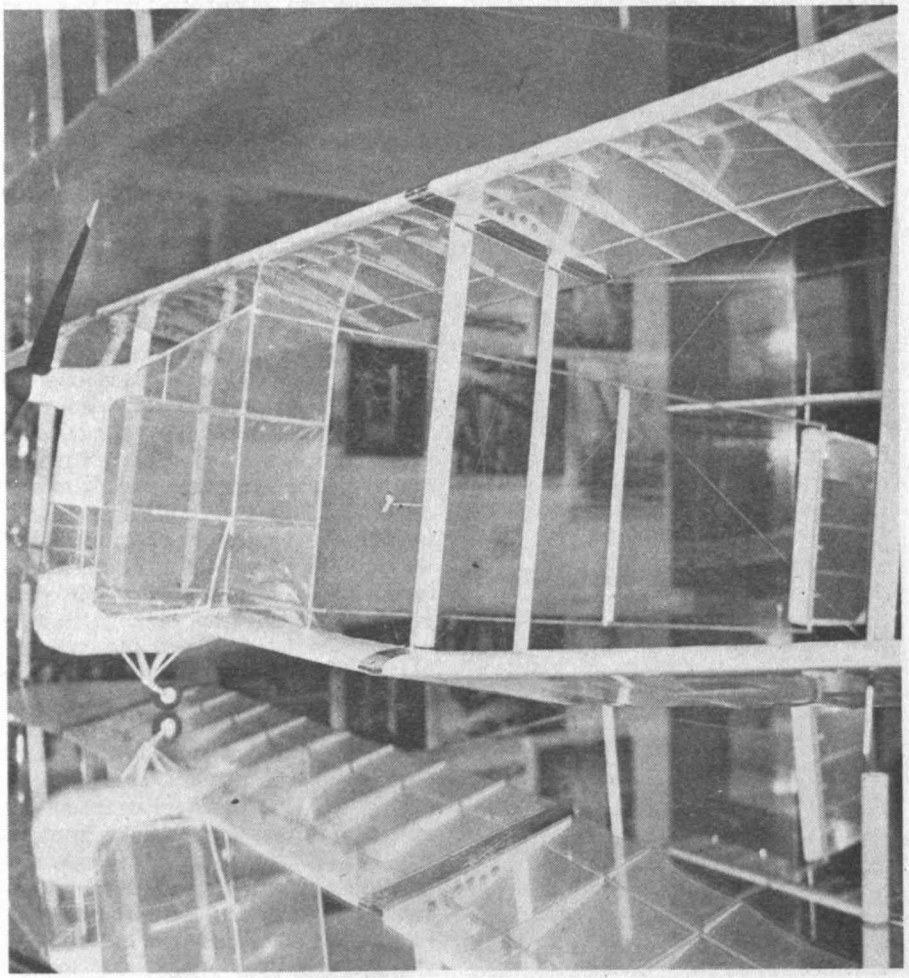




First it was a gleam in the eye of Warren A. Seamans (top, left), who began by finding and polishing the Institute's bust of its founder, William Barton Rogers (left). Then began a trickle—since become a landslide—of gifts and acquisitions for the M.I.T. Museum, among them the collection of globes formed by the late Harry H. Young, '90, and the original "brass rat," a gift of the Class of 1951. (Photos on pages A7-A10, James J. Snyder, '80)



What used to be someone's storage problem has been turned by the M.I.T. Museum into a prideful exhibition of the Institute's achievements: renderings for architectural theses (above), awards to long-forgotten athletes (right), and a model of the successful human-powered aircraft Chrysalis (right). And special events, such as the 80th birthday of President-Emeritus Julius A. Stratton, '23, have been enriched by special exhibits (opposite, top).



and furniture in a cluttered room with flash lights"—and there suddenly was a portrait which was easily recognizable as William Barton Rogers, M.I.T.'s founder.

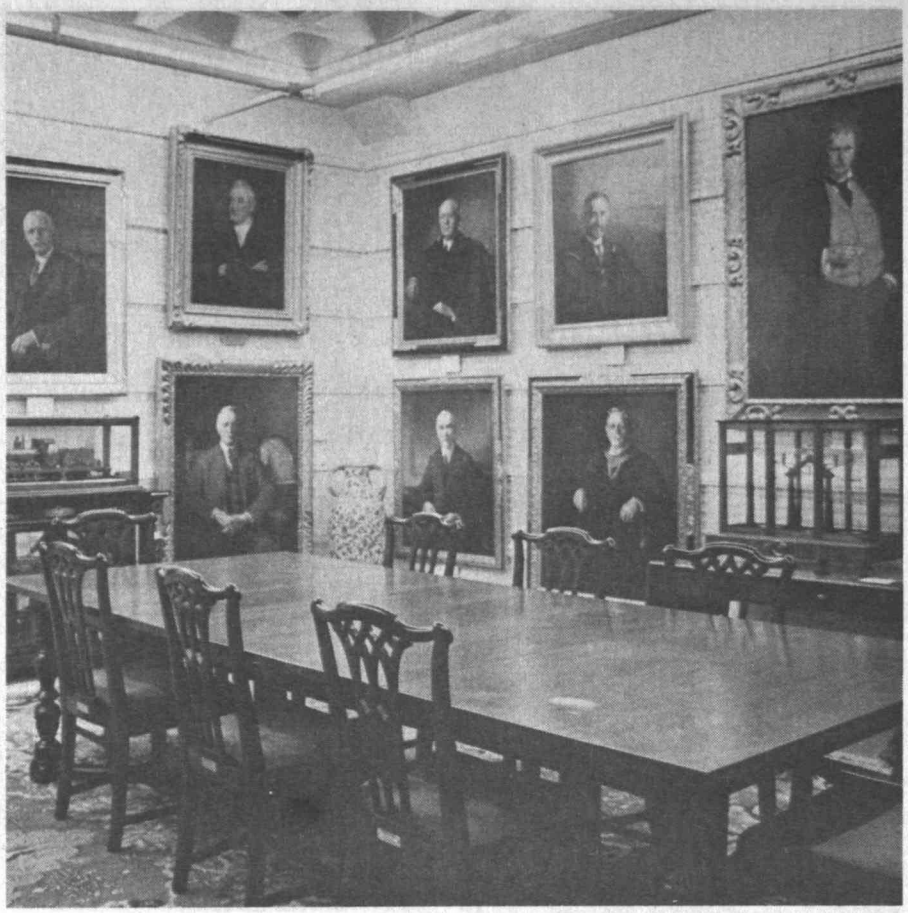
Bright and early next morning Warren Seamans proudly carried his new prize to Howard W. Johnson, chairman of the Corporation, and from that moment emerged their resolution that the Institute should take better care of its priceless past—and Mr. Seamans' vision for how it should be done. Since them "it's been very exciting. . . . I wouldn't trade jobs with anyone on campus," he says.

Professor Richard M. Douglas, who was then head of the Humanities Department, remembers it a little differently. Mr. Seamans became "the administrative officer who never showed up for work," he recalled at a celebration of the M.I.T. Museum's tenth anniversary last fall—the victim of a rare fever which turns its host into an inveterate collector: "When you get it you can't get rid of it," Professor Douglas explained.

Mr. Seamans' disease was officially recognized later in 1971, when a Committee for Institute Memorabilia was formed with Mr. Johnson as its chairman. By 1972 that dusty room where the Rogers portrait was first found became Mr. Seamans' office, and M.I.T. Historical Collections had its first 800

Continued on page A 10

An essential criterion of a proper museum, explains Warren Seamans, director of the M.I.T. Museum and Historical Collections, is that it reaches into its community, that its materials are more than just passively available to those who happen to know and want them. It was in pursuit of that philosophy that selections from M.I.T.'s Forbes Whaling Collection—prints, models, and memorabilia—were exhibited last fall at the State Street Bank and Trust Co.'s main office in Boston. Left to right at the opening (above): Mr. Seamans, whose M.I.T. Museum holds the Forbes collection; William S. Edgerly, '49, president of the bank; and Allen Forbes, Jr., whose father formed the collection during and after his 39-year presidency of the bank. (Photo: Calvin Campbell)



The M.I.T. Museum's portrait gallery is a popular conference site. The portraits are those of early benefactors, administrators, and teachers—among them Theodore Vail, whose outstanding electrical engineering collection formed the nucleus of today's Barker Library, and Elihu Thomson, twice acting president of M.I.T.

square feet of space. And Mr. Seamans remembers a confident directive from James R. Killian, Jr., '26, who was then honorary chairman of the Corporation: "Do whatever is necessary to save the Institute's visual memorabilia."

Turning Hand-Me-Downs Into Collectibles

Though there were no self-evident sources of materials when Mr. Seamans began the task, formation of Historical Collections was greeted with literally a torrent of material. Some of it, at least, came from people who had no time for the past because they were too busy "surpassing the present and inventing the future," in the words of Professor Douglas—and they were glad enough to find someone to accept the responsibility for the past which they didn't want. But nothing was unwanted, and it is a tribute to Mr. Seamans and his staff—including some 100 M.I.T. student employees and 20 work-study students from Northeastern since 1971—that these hand-me-downs have been forged into a collection in which nothing seems out of place and everything contributed to the goal of documenting the Institute's 120-year life.

Thousands of photographs came from the News Office and *Technology Review*; records from the construction of the Cambridge buildings came from Stone and Webster, the contractors, and the Department of Architecture gave the exquisite drawings in the beaux-arts tradition which had represented architecture theses for nearly 100 years in the 19th and early 20th centuries. Most recently, the Francis Russell Hart Nautical Museum has come under the M.I.T. Museum's administration.

Now the collection under Mr. Seamans' enthusiastic entrepreneurship has grown to include 750,000 pieces in 20,000 square feet of floor space. Its headquarters are the site for countless alumni and other historically-oriented functions, and the Compton Gallery, over which Mr. Seamans now has responsibility is the locale for major exhibitions of M.I.T. materials and related subjects.

Indeed, in every respect the program has become that of a museum rather than simply a collection, and to recognize that fact the name has been changed: on the tenth anniversary of Mr. Seamans' successful search for the William Barton Rogers portrait, it's officially become the M.I.T. Museum and Historical Collections.

From a Collection Into a Museum

Shows for the Compton Gallery are lined up for almost the next two years—an exhibition of "molecular graphics" (a visual representation of molecules which is both artistic and scientific, Mr. Seamans explains) will come soon, and a show next fall will mark the centennial of electrical engineering at M.I.T. In addition, there are several exhibitions a year at the M.I.T. Museum in Building N52, corridor exhibits ("whenever I go by someone is looking at them," says Mr. Seamans), and travelling shows for professional and alumni meetings.

Mr. Seamans is modest, even shy about it all. He and his colleagues have intentionally kept a low profile, doing things quietly. "I don't think you can force history down anyone's throat," he says. But now history and the M.I.T. Museum's part in it is on almost everyone's mind, and there's a chance for everyone in the community to learn about M.I.T.'s beginnings and achievements. As Mr. Johnson said at a reception to celebrate the Musuem's tenth anniversary, we all share "a sense of delight in what has happened. . . . It's hard to imagine M.I.T. without all the things Warren Seamans has done." The Museum, said Mr. Johnson, is "an essential element in describing this institution, helping us to understand what kind of place M.I.T. was, is, and will be."

During the next ten years, Mr. Seamans wants to "build toward a real museum facility"—larger quarters, closer to the campus. And he hopes soon to be accredited by the American Association of Museums, a certification that the M.I.T. Museum meets accepted standards of handling and exhibiting historical material. For the Institute community, that would seem self-evident: a disordered, forgotten closet has become a collection and now a working museum—"an institution within an institution," said Mr. Johnson—in the short space of a decade.—*J.M.*

New Athletic Center "For Those Who Meet Intellectual And Physical Challenge with Equal Verve"

Nine hands were used to cut the ribbon at the dedication (top) of the $9-million Athletics Center (above) on December 4. Left to right: Jane Betts, assistant director of athletics; Harvey Stenger and Mary Bowden, representing graduate-student users; President Paul E. Gray, '54; Howard W. Johnson, chairman of the Corporation; Ross H. Smith, former director of athletics; Royce N. Flippin, Jr., director of athletics; Patrick A. Robertson, '83, president of the Athletic Association; and Francis E. Low, provost. For everyone concerned, said Professor Flippin, the event brought "a sense of accomplishment, a renewal of commitment, and a strong feeling of joy and celebration." (Photo: Calvin Campbell)

"Not the quarry, but the chase,
Not the laurel, but the race . . ."
—F. Gelett Burgess, 1887

M.I.T.'s new $9-million Athletics Center was officially dedicated last December "with a sense of accomplishment, a renewal of commitment, and a strong feeling of joy and celebration," said M.I.T. athletics director Royce N. Flippin, Jr.

The ceremony was held on a glistening ice rink festooned with pink and white helium-filled balloons in clusters and arcs around a central podium. Outside in the lobby, a huge ice sculpture vase held roses.

"This building is dedicated to the generations of M.I.T.—past, present, and future—who meet intellectual and physical challenge with equal verve and who espouse the ancient ideal of a sound body," reads the inscription.

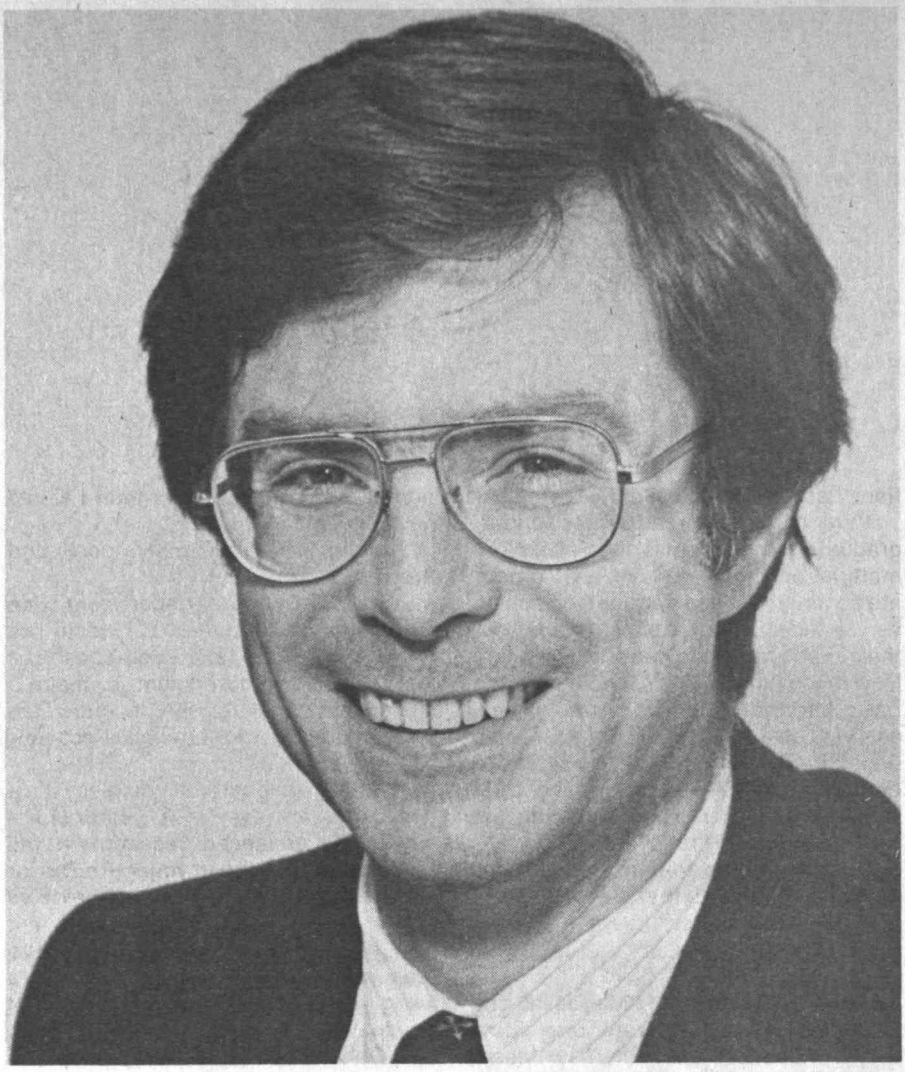
The two-floor structure, designed by Davis, Brody, and Associates of New York and built by Turner Construction Co., contains an ice rink (200 x 85 feet) lobbies, dressing rooms and offices on the first floor. The space can accommodate up to 4,780 people for Institute events.

On the second floor is a larger column-free field house (170 by 320 feet), with four tennis or basketball courts surrounded by a 200-meter Mondo rubber surface running track, only the third of its kind in New England. It can accommodate indoor track and field events such as shot put, pole vault, long and high jump, and weight throw. The maximum capacity of the field house, with its 600 pull-out bleachers, is 3,400.

"The varsity athlete is just one beneficiary of the new facility," said Gordon V. Kelly, head coach of indoor and outdoor track and field. "The largest group to enjoy this building will be the casual or recreational user—skaters, joggers, tennis and basketball players. This building is in motion daily from opening to closing as M.I.T. continues to meet the needs of its entire community."

Said President Paul Gray: "Few would say M.I.T. students need to sharpen their senses of competition. But athletics draw on complementary skills—they contribute to the development of mature, self-sufficient individuals."

Former M.I.T. athletic director Ross H. (Jim) Smith played a prominent role in spearheading the drive to fund the new facility in the mid-1970s. Near the end of the dedication ceremony, Mr. Johnson presented Mr. Smith with a silver bowl on behalf of the M.I.T. Corporation for his efforts in making the new facility a reality.



Teaching Humanities When They're at the Edge of the Plate Instead of the Middle

When Professor Peter Smith taught history at the University of Wisconsin, his students were would-be historians, not budding scientists and engineers. History—and the humanities in general—were their meat and potatoes.

It's different at M.I.T., where Professor Smith came 18 months ago to be associate dean for humanities programs and head of the Department of Humanities. Here most undergraduates are presumed to see their required courses in the humanities as the parsley at the edge of the plate.

"Under these conditions—if they really apply—what message can you hope to put across," I asked Professor Smith, "and how do you do it?"

"We want to expose M.I.T. undergraduates to alternative modes of inquiry that may resemble the scientific methods but that have their own discipline and integrity," he told me. "Rules of understanding apply in both cases.

"It is not that one does serious work in science and engineering and anything goes in the humanities; there is just as much rigor precisely because of some ambiguities of the content. Our mission is less to expose the students to substantive achievements in literature and history, though intellectuals should be acquainted with them. It is more to expose them to alternative modes of analysis that are just as valid as those in science.

"I reject the notion that our mission is recreational," Professor Smith insists. He thinks the stereotype that subjects in humanities are easy courses is furthered by the fact that most of them carry 9 credits instead of the 12 given for most engineering courses. Students quickly enough find the truth. "Serious, heavy reading is assigned. We demand a lot of writing. Our faculty demonstrate by example. For instance," says Dr. Smith, "a professor in humanities might express deep personal commitment: 'This material is worth thinking about; it is an important part of my life. These are good questions—so good that I might not figure them out in my whole professional lifetime.' "

The teaching staff also carries a unique burden. "We have a very professional faculty whose educational mission is almost exclusively at the undergraduate level. How do you nurture the vitality of that faculty under those limita-

tions? asks Professor Smith.

"We can run an advanced undergraduate seminar; but it doesn't explore material on the same level as a graduate seminar. We are frequently teaching very intellectually gifted students, but their exposure to the material is limited. How much time do you spend conveying basic information and how much time can you give to defining difficult questions about what remains to be discovered in the field? We can't do the latter without the former. How much information do you need first?

"I look forward to confronting these dilemmas firsthand; that's why I want to teach next semester," says Professor Smith.

"Do students here have a technical personality?" I asked. "Maybe at one time M.I.T. students were one-sided; that is much less true now," Professor Smith told me. "Entering students have high verbal as well as quantitative skills—a kind of bilateral brilliance. With such students there can be only one approach: teach the best humanities we can. Find the best people in the country to come here. We may stress some technological questions more than other schools might, but I don't think it's watered down.

"We would like to stress the movement back and forth between disciplines; to stress the connections, for example, between literary and political styles. If you read a literary text with rigor, you can gain an understanding of the culture from which it comes that would help explain political and social phenomena."

"How has your perception of M.I.T. changed from before your arrival, as an outsider, to now?" I asked.

"I'm struck by the interest and concern for the humanities here—within the administration and elsewhere around the Institute. I sensed there was support for the humanities here before I came, but I didn't expect it would be so strong. I'm very gratified. Yet that doesn't mean we don't have problems; there are still things to do. But conditions are more propitious than I would have expected."

Among Professor Smith's goals and dreams:

☐ "Now we have a department-wide curriculum committee, and I would like to have this group take a self-conscious look at our own curriculum, to make a sustained study to see if there are things we might do that we're not now doing.

☐ "A long run goal (you could say it's a twinkle in my eye) is a postdoctoral center for advanced research in the humanities, to bring in young Ph.D.s for a semester or a year to pursue their own work, collaborate with our faculty, and give lectures. Their role would be not to teach but to interact with students in a living demonstration of the modes of inquiry which are typical of these fields.

☐ "On another front: many people in our department propose graduate programs; there is none in the humanities. We need those benefits—especially the stimulus that comes from research at an advanced level—but we cannot afford all the costs. Graduate study requires an enormous commitment of resources, and the job market for advanced humanities degrees is dismal. But maybe we can get around those problems in special areas, such as science writing, where I suspect we will soon have a master's program."

"Is attracting faculty a problem?" I asked.

"We had extraordinary good luck in recruiting faculty last year. One attraction is the sheer intellectual capability of M.I.T. undergraduates. They may have less background, but they handle themselves with great precision and intellectual power. That's a great joy.

"A second attraction: M.I.T. is not in isolation; it sits in the midst of a lively intellectual community, providing a lot of what we can't provide directly. An example is access to Harvard's Widener Library. A third attraction: the outstanding faculty we have within the department serves as a magnet."—*M.L.*

The Tech: First 100 Years

What do James R. Killian, Jr. '26, Paul E. Schindler, '74, O. Reid Ashe, Jr., '70, and Stephanie Pollack, '82, have in common?

They were all editors of *The Tech*. And for *The Tech*'s centennial celebration last fall on the exact 100th birthday of the first publication (November 16, 1881—November 16, 1981) they and some 100 other past and present staff members of *The Tech* met for a reunion and celebration. Dinner at the Parker House in downtown Boston, and an exhibition in the Hayden Gallery at M.I.T., marked the occasion.

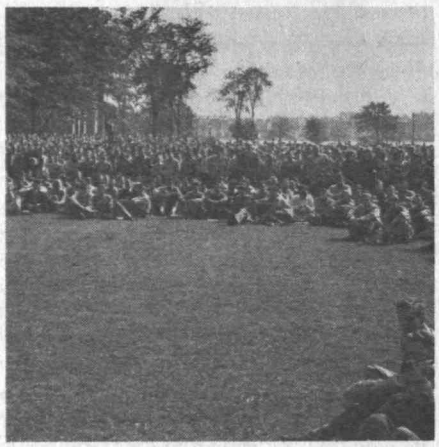
At dinner, James Killian reminisced:

"This is a heartwarming, nostalgic experience for me. I signed up as a staff member of *The Tech* in 1924. Controversial things happened then, and still do. We discovered that *Voodoo* (not published anymore, unfortunately) would bring out an issue with unpleasant things about *The Tech*. We got a copy before it appeared—reproduced it and answered everything they said . . .

"A distinguished professor of English, Winward Prescott, was devoted to *The Tech* and chaired an advisory council. We got together monthly to discuss the three publications on campus (*The Tech*, *Voodoo*, and *Tech Engineering News*). Those "advisory council' meetings were among the most memorable of my experience. . . . How much I owe personally to what *The Tech* did for me!

"I never thought I would be president of M.I.T. in 1924—I would have considered the idea preposterous. I transferred to M.I.T. to study textiles—and was on the verge of accepting two offers, from Goodyear and Goodrich. Then fate intervened and directed me down a less troubled road.

"Senior year, I was editor of *The Tech*. I was an ardent addict of H.L. Mencken; I lambasted the administration in that style. It didn't go unnoticed—I received an invitation to visit the dean of students, Harold E. Lobdell. With stern adroitness, he left me fully aware that my diatribes were jejune and revealed an obvious ignorance of academic administration. But our talk led to an unexpected comradeship. When Dean Lobdell took over *Technology Review* he asked me to do a column on student affairs. So I wrote regular pieces for the magazine, including one in 1925 which spotlighted the decline in enrollment. 'The immediate problem with the Institute is twofold,' I pontificated. 'How may the numbers increase—and how may they be selected with more intelligence?' Lobdell didn't stop me."



Eric Hodgins, who was editor in 1921-22 and later claimed he was awarded his degree in chemical engineering under the condition that he would never practice that profession (he never did), was also a good teacher, recalled Dr. Killian. Indeed, he said, "I would say the training I received under Lobdell and Hodgins led to my election to the editorship of *The Tech*, which proved to be a long drop-kick into the Institute presidency."

Paul Schindler had some advice for his present-day successors: "Most of what you get out of your education at M.I.T. is not in the classroom. Cherish your time at *The Tech*."

O. Reid Ashe, '70, now editor, publisher, and president of the *Jackson* (Tennessee) Sun: "It's nice to retrace the steps we've taken on the path from adolescence to senility.

"I asked myself why the rag lasted. The stock answers don't work: not your own press; not you're first; not the only game in town; not through any continuity of management. Yet here is a newspaper that survived under the same name for 100 years.

"There *is* a reason why, which related to a lesson I learned while I was at M.I.T.: we Americans have a special attachment to newspapers. Our industry enjoys explicit protection in the Constitution of the United States. And *The Tech* made itself an indispensable part of the community it serves.

"We work in a world that's populated with journalism graduates (we're the odd ducks, who came out of M.I.T.). When people learn where we went to school, they do a double-take. I have to explain the term 'time sink.'

I'm proud of *The Tech* and of the Institute for its forebearance and support. M.I.T. supports a press that is free to succeed or fall flat on its face."

The chairman of *The Tech*, Brian J. Glass, '82, takes the stand. He asks the audience to sing Happy Birthday, and they do. Happy birthday, *The Tech*.

From The Tech *centennial issue, some visual slices of history:*

Construction of the New Technology was a formidable task: 22,000 piles were used to keep the buildings from sinking. The site had been filled in with Charles River mud (this page, top).

Students gathered in the Great Court (now Killian Court) in May of 1945 to celebrate victory in Europe (this page, bottom).

This 1925 freshman tug-of-war team took competition seriously (opposite page, top).

M.I.T. began admitting women as regular students in 1883, and two dozen were attending the Institute in 1888. Ellen Swallow Richards, M.I.T.'s first coed, is shown at the extreme left in the rear (opposite page, bottom). (Photos: M.I.T. Museum)

Centennial Issue: Journey into History

The Tech published a centennial issue to commemorate its 100th birthday on November 16, 1981.

Excerpts from its elaborate journey into history:

The paper originally had a larger scope than does *The Tech* of recent years, covering topics ranging from world affairs, scientific treatises, and Institute particulars to student literary attempts. For example, an editorial observation in the November 30, 1981, issue read: "The Policy of the English government in regard to the Irish question has been, up to this time, a lenient one. . . Measures should be taken to suppress the thing once and for all." Closer to home, a letter to the editor on the need for a break in the work at M.I.T. stated a prevailing opinion: "Mentally the rest is needed. We as students scarcely need to be assured of this for every man who knows the mental strain of six days' close application, must feel its necessity."

M.I.T. was not and never will be confined to its campus alone. Even in 1896, the Institute was making national headlines. This time the news came from Greenland that Professor Alfred E. Burton and a party of Institute students and instructors were with the sixth Peary expedition to the North Pole. Professor Burton reported in *The Tech* that their location had on "its shores some of the largest and most prosperous Eskimo settlements. The upper end of the fjord seems never before to have been visited by an American party." Using magnetic and pendulum observations, the M.I.T. group made some of the most accurate maps then available. At the end of the journey, Professor Helmert made a report to the Geodetic Association about the purpose of the expedition: to determine the force of gravity at the pole and to deduce the figure of the earth's curvature.

President Walker was superbly characterized by one writer: "Through the tide of student life which daily ebbs and flows in the great hall of Rogers, has moved for fifteen years one believed, commanding figure. Alert, erect, and strikingly handsome, always bending in graceful recognition of the shower of salutes which welcomed his appearance, he passed quickly on into the president's office."

In the ten years after 1910 M.I.T. was to see many significant changes: three years later the school moved from near Copley Square to the present site.

During the next ten years, *The Tech* headlines more often then not contained the word *change*—everything was changing, from registration material to drinking fountains. As reported in 1910, "The drinking cup is shuffling off this mortal coil. . . . Bubbling fountains are to be installed all over the Institute."

As usual, money was the primary factor determining how quickly New Technology could be ready for students. Alumni and friends rallied to the cause, however. The following spring, *The Tech* joyously recorded an unexpected burst of fortune. This time, the banner read "Institute Receives Anonymous Gift; Two and Half Million For Fund,: and a subhead added "Site Practically Clear; Cement for Buildings Ready to Ship." The story explained that, "Yesterday afternoon, President Maclaurin made the startling announcement that an anonymous donor had added the sum of $2,500,000 to the building fund. This is a gift which has probably never been equaled by any living man in bestowing money on an institution of learning. It will enable the alumni to center practically their entire attention on the question of raising money to equip the New Institute, and to build whatever dormitories and social gathering places they may feel are needed." This anonymous "Mr. Smith" was later revealed to be George Eastman, whose beneficence did not end with this huge gift.

From a letter from President Gray for the Centennial Issue:

"Besides printing news of interest and importance to our community, the paper has become a forum for the varied voices which may arise on any given issue. As you know, I don't always agree with the views expressed in your paper, but what kind of university would we be without the dialectic generated by differing perspectives and assumptions? If there is anything I've learned in my thirty years as an M.I.T. citizen, it is that this place and its people flourish by challenging old truths and creating new paradigms for understanding ourselves and our world. This spirit is embodied in *The Tech*—a tradition that serves us all."

C.D.C. and Sustaining Fellows:

Vice-President Bush Urges Nuclear Power and Arms Reduction While Johnson and Gray Give Good and Bad Notices to Reagan Policies

It was a coup for the M.I.T. Sustaining Fellows—those whose annual gifts to the Institute for unrestricted purposes or endowment are $2,000 or more, and those whose cumulative giving for these purposes has reached $25,000 or more: Vice-President George Bush would be their guest at their annual dinner meeting on October 30.

The announcement stimulated a record attendance of sustaining fellows and their guests, who heard the vice-president defend the Reagan administration's determination to "modernize" U.S. nuclear forces in Europe: "Since 1979," said Mr. Bush, "the Soviet Union has deployed over 300 SS-20 nuclear warheads. That is to say: every two days, the Soviet Union has deployed a warhead lethal enough to destroy a major European city." Meanwhile, Mr. Bush said, "The U.S. has withdrawn 1,000 nuclear weapons from Europe, with no plans for replacing them."

But "the policy of the United States, the policy of Nato—is one of deterrence," Mr. Bush declared. "Deterrence is a remarkably effective way of avoiding the horrors of modern-day warfare: . . . make it clear to an aggressor that he has nothing to gain by striking except his own destruction, chances are he will not strike.

"History has shown it to be true, and it is a lesson that we cannot afford suddenly to start ignoring."

At the same time, the vice-president assured his audience that the U.S. is "against nuclear war.

"This administration has said time after time that it wants real and verifiable arms reduction," Mr. Bush declared. "In the past we have talked about arms limitation. We say that's not enough. We want arms reduction. To talk about limiting the growth of weapons is better than nothing, but actually to reduce that growth would be a much greater achievement. This administration is prepared to put everything on the table, and to stay at that table with the Soviets until they agree not just to slow down but to reverse the deadly trend of the nuclear age.

"One great advantage to the modernization program is that it got the Soviet Union finally to sit down at the bargaining table. Without it there would have been no prospect of limiting the Soviet threat to Europe," Mr. Bush declared.

While all this was going on in du Pont Gymnasium, some 2,000 protesters from throughout Greater Boston were demonstrating outside the Stratton Student Center on behalf of a host of anti-Reagan causes. A burning of Vice-President Bush in effigy brought the Cambridge Fire Department, and even the vice-president himself acknowledged the episode: "I hope that my presence here hasn't complicated your lives in any way," he said, in response to Howard W. Johnson's introduction.

To some the atmosphere was reminiscent of the 1960s, when students paraded through the Institute to oppose the nation's Viet Nam policies and M.I.T.'s support of them through defense research. But to other observers the 2,000 demonstrators organized by—among others—the "M.I.T. Committee on Central America" and the "Anti-War Organization League" were less than impressive. Wrote Kevin Smith, '84, in *The Tech*: "The lead on the 11 o'clock news should have been, 'In Cambridge tonight 50 to 100 students protested Vice-President Bush's visit to M.I.T. In an unrelated event, approximately 1,800 loud, obnoxious, bizarrely dressed crazies mysteriously gathered around 77 Massachusetts Avenue, chanting nonsense and starting fires.'

Maintaining Momentum to Meet New Needs

Earlier in the day, most of the Sustaining Fellows had joined members of the Corporation Development Committee for their annual meeting to review M.I.T.'s financial development efforts. In the wake of record giving to M.I.T. in the fiscal year ending June 30, 1981, Mr. Johnson was optimistic: the level of annual giving to M.I.T. was $20 million in the years immediately preceding the Leadership Campaign, and it has now risen to at least $35 to $38 million (giving in 1979-80 was $33.8 million and in 1980-81, $42.9 million).

Pledges now outstanding to M.I.T. are over $50 million, some $4 million higher than at the same time a year ago, Mr. Johnson said. And proposals to would-be donors for over $20 million are now outstanding, compared with less than $12 million a year before.

Furthermore, Glenn P. Strehel, '58, treasurer, told members of the C.D.C. that the Reagan administraton's new tax program should benefit M.I.T. by leaving more discretionary income in the hands of "our most important class" of donors.

But there are clouds inside this silver lining, agreed Mr. Johnson and President Gray. The pace of inflation means that the change in annual giving from $20 to $35 million in a decade is not so significant as it sounds. Indeed, President Gray said, inflation "forces us to run harder and harder just to keep from losing ground."

Furthermore, Dr. Gray told the C.D.C., the Institute has continuing need for new and improved facilities to keep pace with new demands—a new physics building in which to centralize a department now dispersed through many Institute locations, an arts and media technology center, and new facilities for microsystems research, brain science, engineering design, and technology management.

In addition, Dr. Gray warned of the effects of cutbacks in federal student and research support—especially "ill-informed cutbacks in the support of social science research." Though he does not expect private sources to substitute for all these losses, Dr. Gray said, there must be significant efforts to cultivate more individual and corporate donors and to "maintain the momentum of the Leadership Campaign." But this does not mean, Dr. Gray said, another "major capital campaign."

Classes

10

Since we have lost our class president and secretary *(see* Technology Review, *January 1982, p. B2.),* I will be writing our class news. Our sympathy to Mrs. Weldon and all the family.

Chester W. Wilson died November 23, 1980. Chet and his wife Helen lived for many years in West Newton, Mass., but several years ago moved to Barrington, N.H., to be near their daughter Claire and her husband, Paul Wright. The Wrights had built an apartment complex which resembled a "covered bridge," and Chet and Helen occupied one of the apartments. Helen still does. When Chet and I were going to "Boston Tech," Chet and his family lived in Newton. On several occasions I was invited to his home for a Sunday dinner—occasions long remembered. Our sympathy to Helen and Claire and all the family.—**Fred R. Lufkin**, Acting Secretary, 24 Linden St., Portland, ME 04103

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John Homan II spent two months in England last summer. He enjoys his four games of golf each week. . . . Aside from guest Barbara Thomas, **Waldo Pike**, his daughter, and **Evers Burtner** were at the 1915 table at the Alumni Day Luncheon last June. . . . It is sad to report that **Dewitt Ramsay** passed away November 21 1981, due to pneumonia after a successful hip operation. He will be greatly missed.—**Evers Burtner**, Acting Assistant Secretary, Box 286A, Rt. 1, Kingston, NH 03848; **Azel Mack**, Secretary, 7 Atwood St., Wellesley, MA 02181

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As this is being written **Ralph Fletcher** is in flight to Florida for a few days in the sunny south. While there he and Sibyl planned to have lunch with Hildegarde Carr. . . . The mail, again, is light. **Joel Connolly** sent a nice card with his best wishes for a Happy Birthday, a Merry Christmas and a Happy New Year. Also, **Val Ellicott** writes, "My wife, Mary, and I are enjoying our life here in Broadmead, a lifetime care community operated by the Quakers."

As we near the end of the winter, it is timely to be thinking about our 66th Reunion. We are considering a luncheon in late May or early June and not having a three-day reunion as we did each year for the last 30 years. Let us have your suggestions to guide us in making this decision. We'll be looking forward to hearing from many of our 75 or more classmates with ideas on what we should do for our 66th Reunion in 1982. Keep eating, drinking, walking, breathing, everything in moderation, and yes, of course, keep writing.—**Ralph A. Fletcher**, Acting Secretary, West Chelmsford, MA 01863

17 65th Reunion

An interesting letter from Helen Wood tells of the happenings with the **Jack Wood** family. This past year has been a tough one for Jack starting with cancer surgery a year ago last December. Then, this past October some heart and circulatory troubles led to the amputation of his right leg below the knee. He is using a walker now and convalescing well: two weeks later Jack attended the Pacific Coast Yacht Racing Assoc. Hall of Fame banquet at the San Diego Yacht Club. For the story of how Jack got started with the M.I.T. sailing see Page A17 of the October *Review.* A recent issue of *Tech Talk*, also ran a good story on Jack's success as instigator of collegiate sailing. Helen has had arthritic troubles so has given up her dancing and performing.

Judging from returns to the Reunion letter we octogenarians are being caught up with more canes, more hearing aids, and less driving, along with other things such as **Ray Stevens** is experiencing. Since last summer Ray has been fighting a kidney condition which has had him in the Massachusetts General Hospital and presently in a nursing home. He may shoot me for this mention. . . . Quite a few of us are indefinite about coming to the Reunion because of various uncertainties but add the **Ken Lanes**, **Bill Sullivan**, and **Ray Brooks** to the list given in the January class notes as coming. Because of your overwhelming response to the question about Pops, our class will be having an elegant reception and dinner at Endicott House in Dedham, Thursday, June 10.

How's this, via **Tubby Strout**, on **Ray Brooks**, the man who "lacks stamina": "Just returned from a wonderful week at the Confederate Air Force Air Show '81 in Harlingen, Tex. where I was flown by my good friend Edward Lawler in his Cessna 340 bird. I am familiar with that territory from when, in 1919, I visited South Padre Island. At the time there was nothing but a fisherman's shack—today there are high rise steel and concrete hotels, motels, and restaurants. There were four of us in Lawler's plane and we covered 3,600 miles including stops on the return trip at Greenville on the 'Ole Mississippi, and Staunton, Va."

After Tubby's letter, I received word directly from Ray, with this additional news: "Several months ago I received a letter saying that the Aces of World War I from various countries were to be entertained in Paris, France, and would I be interested. 'You bet.' I said, and proceeded to stand by. The sponsors were Air France, United Airlines, the French government, the embassies of several nations, and an anonymous giver, allowing us to have a week of utmost comfort, luxury, and complete red carpet treatment with many exciting appearances in the city that I have been in love with since 1918. Some of the highlights were special events in French governmental departments, including military escorts through the impossible Paris traffic. The museum meetings and Arc de Triomphe ceremony were another part of the red carpet assemblies. Every moment of every day during our hours awake were complete in happy occurrances. The landing at Kennedy on Long Island, N.Y., with me sitting behind the pilot in the Concorde cockpit was the biggest thrill—which is still emotionally with me days later as I state this."

Ray Brooks, D.S.C. is retired from the Bell Laboratories. After the war he helped develop the air mail service as well as aircraft communications and navigation systems. He continues to get cards and letters from young people asking for autographs and souvenirs of the war.—**Stanley C. Dunning**, Acting Secretary, 33 Christian Ave., Box 218, Concord, NH 03301

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Another month gone by with the minimum of news from all of you.In the meantime, I try to keep in touch with M.I.T. so I can record some of the activities. The Margaret Compton Gallery recently featured "100 Years of the Tech." Issues of *The Spectrum* were on display, and there was a particular nostalgia in those of 1914-1918. Our own **Kea Reid** was editor-in-chief of the paper in 1918.

Congratulations to **Harold Weber** on his election as a fellow of the American Institute of Chemical Engineers.

Selma and I recently saw Jean and **Julian Avery**. Jean had just returned from a happy three-week vacation with her daughter and family in France. Julian has resolved the patent problems with his new improved process for manufacturing magnesium. We wish him much deserved success in this important development. . . . Eleanor (Mrs. **John) Kilduff** sends a kind note and says she is about to leave New Hampshire for a winter stay in her Florda home. . . . Hazel (Mrs. **Saxton) Fletcher** is going to spend the winter months in Portugal. . .

Elizabeth (Mrs. **Julian) Hose** is fine. We enjoyed a most delicious luncheon and afternoon of light and heavy chatter with her.

Gladys Fisher writes, "It is with great sadness that I inform you that my husband, **William Penn Fisher, Jr.** (Bill) died June 6, 1981, after a short illness due to a weakened condition and resulting complications. Bill left Princeton University at the end of his freshman year, transferred to M.I.T. and graduated three years later in chemical engineering. He kept in close touch with several of his classmates, all of whom preceded him in death. We lived in the Wilmington vicinity for the past 31 years and enjoyed many M.I.T. gatherings during our 50 years of marriage." Our deep sympathy goes to Gladys.—**Max Seltzer**, Secretary, 1443 Beacon St., Brookline, MA 02146 and **Leonard L. Levine**, Assistant Secretary, 519 Washington St., Brookline, MA 02146

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It is a real thrill to have a telephone conversation with a 1919 classmate. Such was true when I spoke with **Oscar de Lima**—I found him and his wife in good health and very active, and we enjoyed talking to each other about other classmates. . . . I also spoke with **Don Way**, president of our class and it seems **Dean Webster**, who is our class agent, is ill in the hospital and unable to function as the agent. So Don is in the process of naming another classmate, hopefully only tempo-

rary.

Wayland S. Bailey writes that as chairman of the buildings and grounds committee of the First Parish in Norwell he spends his spare time with his brother keeping the minister and the steeple clock behaving. Wayland does very little traveling, but enjoys watching the youngsters grow up, including a first great-granddaughter who is talking a blue streak. . . . **George R. Bond, Jr.**, enjoys our great world being still able to travel. Last Spring he went on a cruise to many Caribbean Islands and Venezuela. At home he continues his many activities including a Boy Scout troop and church.

Francis Weiskittel is grateful for good health and activity at 83 years. He still works on his five acre grounds cutting honeysuckle off chain link fences, etc., but not enough to interfere with taking his son for their ninth visit to Disney World. . .

Now I hope you enjoy these little notes from your classmates, please keep them coming.—**W. Longille**, Secretary, Box 144, Gladstone, NJ 07934

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It was pleasing to hear from **Larry Weymouth** who is enjoying Florida living. He is a member of the M.I.T. Club of Tampa Bay, one of only two classmates out of 150 members. Larry retired from Johns-Manville in 1962 after 35 years with the company. He moved to Florida from New Jersey four years ago.

Word has been received of the death of **Jean Beique** of 4300 De Maisonneuve, Westmount, Montreal, Canada, on June 13 of last year.

On November 10, Mina and **Perk Bugbee** attended a dedication ceremony at the handsome new building of the National Fire Protection Assoc. in Quincy Mass., to be named the Percy Bugbee Conference Center. . . . A cheerful note from **Norrie Abbott** contains the good news that he is still playing golf and gets a kick out of watching the arrival of the huge car carrier ships from Japan as they wend their way past his apartment on Narragansett Bay.—**Harold Bugbee**, Secretary, 21 Everell Road, Winchester, MA 01890

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James R. Cudworth of Tuscaloosa, Ala., died June 14, 1981. Jim had a long and distinguished career with the University of Alabama retiring on July 1, 1968 as dean emeritus and professor of engineering. Besides M.I.T., he also attended Harvard and the University of Alabama where he earned a master's and a doctor's degree. He was director of Alabama's School of Mines and dean of the College of Engineering for many years. During his career Jim was a consultant for the War Department, the Commerce Department, the Department of the Interior, the TVA, the U.S. Bureau of Mines, and several large metal companies. He and his wife Emily attended our 50th Reunion in 1971.

Another death reported this month is that of **Austin N. Kirkpatrick** of Hyannis, Mass. on September 1, 1981. Your secretary remembers seeing Kirk almost daily as a fellow undergraduate living in Runkle Hall and rooming with **Alexander LaPointe**, now also deceased. Kirk got into sales work after graduation, was in several businesses of his own, and in 1971 was working for Fuller Construction Co. in Hyannis doing electrical contracting. The sympathy of the class goes out to the families of these two men.

An Alumni Fund envelope brings news from Phil Payson of Fort Myers, Fla.: "Marion and I enjoyed our 60th Reunion and the complete report of it in the October 1981 issue of *Technology Review*. After leaving Cambridge on June 6, we drove to Manchester, N.H., to see my two sisters and then to Farmington, N.H., to visit Marion's nephew, commissioner of natural resources for the state, and then on to Alton, N.H., to visit Marion's sister. We also visited Laconia, N.H., where I graduated from high school in 1917." Phil and Marion left New Hampshire to drive to Cleveland to visit their daughter Audrey. Before retiring in 1963, Phil was Cleveland district manager of SKF Industries for many years. Phil was one of a large contingent of Florida residents attending our 60th Reunion. He says he is now 83 years of age. We admire the Payson's stamina in driving those long distances.

That's all the news for this month. I wish I had more to report.—**Sumner Hayward**, Secretary, 224 Richards Rd., Ridgewood, NJ 07450; **Josiah D. Crosby**, Assistant Secretary, 3310 Sheffield Circle, Sarasota, FL 33579; **Samuel E. Lunden**, Assistant Secretary, 1149 S. Broadway, Suite B-800, Los Angeles, CA 90015

22 60th Reunion

The memories of our 55th Reunion still creep up as we approach the 60th next year. We retrieved a very nice ashtray from the Spalding Inn Club in the White Mountains which has been an attractive decoration for my office. I also have a particularly good picture of a group of '22ers taken by **Fay S. Lincoln** of New York City, a class member and famous photographer. This picture was taken in my room at the Statler several years ago as we gathered for the Alumni Banquet. We see **Frank Wing**, **Roscoe Sherbrooke**, **John Vaupel**, **Hugh Shirey**, **Whit Ferguson**, **Clayt Grover**, **Bob Tonon**, **Yardley Chittick**, **Earl (Buck) Eacker**, **Parke Appel**, **Warren Ferguson**, **Oscar Horovitz**, **Dewey Godard**, **Dale Spoor**, **Fearing Pratt**, Randy Meyers, Judy Lincoln, and Mrs. Chittick. It's natural to suppose that some of us may have visibly added our years and some are with us only in very pleasant memories. It is hoped that many of us will attend our Reunion in June to study this picture.

Your Secretary was happy to be in Boston on Ocotber 30 of last year to see Vice-President George Bush "attract 2000 protesters" on Massachusetts Avenue during the annual dinner of the Sustaining Fellows. Mr. Bush was very popular with most people except those who were against the United States' foreign and domestic policies. . . . The push is on in the western New York area for a rebirth of the M.I.T. Club and new programs for this winter season. Larry Milan of the Alumni Association, assisted by a former M.I.T. Provost Walter Rosenblith, showed us slides of what's happening at M.I.T. The Institute is as attractive to visit as ever, and we hope that many of you will walk into the various offices and have a visit when you are in the Cambridge area.

Your Secretary was in Hingham, Mass., on last November 1 attending the wedding of his grandson. It was in a beautiful church near Fearing Pratt's who I called to say "hello."

S. H. Manian, '22

Samuel H. Manian of North Attleboro, Mass., died November 1, 1981, at age 82. Mr. Manian was a chemical engineer for the U.S. government for more than 20 years, retiring in 1966 from the National Academy of Sciences in Washington, D.C. He was listed in the 11th edition of *American Men of Science*. After graduating from M.I.T. in chemical engineering, he went on to receive his Ph.D. from Columbia University in the same field. During his early career he worked for the E. R. Squibb Co., Kendall Mills and in 1942 became professor of physical chemistry at the University of Cincinnati. From 1942 to 1945, he was chief of the Aromatic Petroleum Solvents Union of the Chemical Bureau of the War Production Board, and from 1945 to 1946 served with the Allied Commission during World War II and was chief of the pharmaceutical division in Italy. Mr. Manian came to America in 1907 from Harpoot, Armenia. Among his many other honors, he was a past treasurer of the M.I.T. Club of Washington, D.C., past president of the Armenian Scientific Assn., past treasurer of the Knights of Vartan, and a 50-year member of the American Chemical Society. He leaves his wife, Esther (Hoogasian); three sons, Samuel R. of Boston, Peter of New York, and Philip Manian of North Attleboro; and two brothers. The sympathy of the class is extended to his family.

We are sorry to announce the loss of **Wyatt H. Ingram** of Ocean Beach, Fire Island, NY 11770. Our sympathy goes to Mrs. Margaret N. Ingram. . .

We also report the loss of and send sympathy to the family of **J. Cecil Aronson** of Winter Park, Fla., and **Howard A. Simons** of Vancouver, B.C. Canada.

Please make us appreciate this beautiful sunny fall weather in Buffalo by writing your good news to your Secretary.—**Whitworth Ferguson**, Secretary, 333 Ellicott Street, Buffalo, NY 14203; **Oscar Horovitz**, Assistant Secretary, 3001 South Course Dr., Pompano Beach, FL 33060

Five Ida M. Green Fellows and three honorary Fellows met last fall with Ida and Cecil Green, '23, of Dallas, Tex., whose gift established the fellowships to support women through their first year of graduate study at M.I.T. Seated (left to right) are Susan Muller, Mr. Green, Mrs. Green, and Lorraine Olson. Standing are Alexana Roshko, Margaret Goud, Juliette Levin, Susan Dexheimer, Lynn Paquette, and Anne Bickford. Absent is Lyne Butler. The fellows, whose average age is 22, were nominated by department heads and professors on the basis of their potential for graduate study and creative research. (Photo: Calvin Campbell)

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The *East Lauderdale News* (Ala.) reports that the County Humane Society Animal Shelter in Florence is having its building and water successfully heated by burning methane gas obtained from a sanitary landfill by methods developed by **Atherton Hastings** (*see April 1981 Class Notes*). Atherton has had a considerable career in chemical engineering. He worked with the Department of Agriculture, and Allied Chemical Corp., then he designed chemical plants in Russia, and was a civil engineer on an Indian reservation in Rosebud, S.D. Later he did oil refinery research in petroleum and natural gas, and then worked from 1941 to 1966 with the TA National Fertilizer Center, from which he retired.

Brinton Thompson reports that he is 83 years old, and celebrated his 50th wedding anniversary August 1, 1981 with his three children and seven grandchildren present. Congratulations Brinton.

An eight-page pamphlet, "50 Years of Innovation—The History of Texas Instruments," has been received from the Alumni Office and makes very interesting reading. The firm was founded by **Cecil Green** and others. Cecil is one of the Institute's great benefactors and now is an honorary director of the firm.

Royal Sterling, chairman of the 60th Reunion committee, has plans well under way. **Pete Pennypacker** is entertainment chairman, and **Bert McKittrick** is in charge of guests. Royal has reserved the Lighthouse Inn at West Dennis (where we were on our 55th Reunion) following the doings in Cambridge.

George Leeds died August 25, 1981. He graduated in mechanical engineering and was president of Dodge and Seymour of New York City, until his retirement to St. Moritz, Switzerland, where he died.—**Richard H. Frazier**, Secretary-Treasurer, 7 Summit Ave., Winchester, MA 01890

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Please refer to your November/December *Review* for two reasons. The first, on page A5 in the upper left hand corner is an untitled picture of three men. Your two secretaries are listening to the uncontrolled rhetoric of **Don Moore**, class executive vice president. The *Review*'s editor John Mattill tried to learn his name from your scribe, but his written request was delayed three weeks in the new speedy 20 cent mail. Secondly, there were no 1924 Notes because Russ missed the deadline for the first time on the job. In retrospect, there was practically nothing to report anyway but in this issue, we are happy to note that Dr. **R. Bruce Lindsay**, was awarded in 1981 the Acoustical Society of America Distinguished Service Citation to add to a long list of honorary trophies. . . . **John Gegan** also lets us know that he is retired from the Providence area of New England Telephone and always retained his rank of colonel, United States Army.

Donald O. Kennedy passed away October 28, 1981 in Sun City, Ariz. He graduated in mining engineering and after beginning his mining career with Mexican companies, he joined the U.S. Bureau of Mines in 1942, and continued there until retiring in 1967 when he was area director in Knoxville, Tenn. . . . **John J. Balfe, Jr.** died September 11, 1981, in Weymouth, Mass. He followed civil engineering with us, earned a master's degree from Harvard, and spent his entire career in education, retiring in 1972 as superintendent of the Cambridge, Mass. school system.

Roland Black writes, "In September Martha and I took our first trip abroad. We visited Copenhagen, took an interesting train trip to Stockholm, a night boat to Helsinki, and a plane to Leningrad. There were bicycle paths everywhere with separate street signals except in Leningrad—where there were no bikes but there were castles and palaces of which there is no U.S. equivalent. The streets were generally cleaner than in U.S.—Leningrad has many plusses and minuses. I was glad when I got back to Helsinki—the trip was worth while."

Chris Conway writes, "I was a delegate to the Sierra Club international convention in Louisville in late June. It was a very inspirational and enjoyable three days. I also spent a week in San Antonio—a very interesting city and loaded with tourists. I am still continuing with my hobbies (I won another gardening award), church activities, community theater, and community concerts. I visit New Orleans about once a month to get a taste of big city life."

The quartet which manned the October 28 Telethon, **Herb Stewart, Don Moore, Avery Morton**, and **Ted Burkholder**, discovered interesting classmate contacts. One call revealed the death of **Willard Gideon** on March 15, 1981 in Arlington, Va., who earned his degree in electrical engineering and had been with Virginia Public Service for years. His wife kindly advised that she would carry out Willard's wish to support the Alumni Fund. We are very grateful to her.—Co-Secretaries: **Russell W. Ambach**, #503, 216 St. Paul St., Brookline MA 02146; **Herbert R. Stewart**, 8 Pilgrim Rd., Waban, MA 02168

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Notes from two classmates are much appreciated. **Temple C. Patton** has most certainly kept busy since retiring from N.L. Industries in 1969. His technical writings have resulted in two publications from John Wiley & Sons: *Paint Flow and Pigment Dispersion, a Rheological Approach to Coating and Ink Technology* (1979) and a three volume (1,978 page) *Pigment Handbook* to which he contributed and acted as editor (1973). More recently he published a chess pamphlet, "Center Counter Gambit." Temple closes saying he enjoys hearing news from classmates which points up the need for more reports from all of you. . . . **William Muschenheim** writes that his "Why Architecture?" was published by Karoma Publishers of Ann Arbor, Mich., in 1980.

Five classmates made the first meeting of the Alumni Council in October. Present were **Jim Howard, Will Gardiner, Ed McLaughlin, Sam Spiker**, and yours truly. Ed, as you know, is now the class agent and will be glad to hear from classmates and will acknowledge your gifts to the Alumni Fund with a note. Keep him busy.

It is with sorrow that I must report the passing of Francis (Frank) J. Turnbull in Milton, Mass., on October 24, 1981. We extend condolences to his survivors which include his wife Ruth A. (Fessler) Turnbull, two daughters Anne M. Phelan of Milton and Mary Elizabeth Jackson of Norwell, Mass., and two sons David J. of Milton and John F. of Pittsburg, Pa. Following graduation Frank worked as a mechanical contractor from 1926 to 1936, and then went with the Frigidaire Division of General Motors from 1936 to 1941. In 1941 he joined the firm of Fay, Spofford & Thorndike of Boston and except for the period from 1943 to 1945 (when he was at the radiation laboratory at M.I.T.), he continued there until his retirement. Those who have attended reunions will remember that Frank was always willing to serve on our committees. He was ever ready to do things for the class and participated in several telethons.—**F. Leroy (Doc) Foster**, Secretary, 434 Old Comers Rd., P.O. Box 331, North Chatham, MA 02650

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A letter from the National Audubon Society announces that **Richard H. Pough** received the Audubon Medal for distinguished service in the cause of conservation on November 5 at the annual Audubon dinner in New York City. In his opening remarks the Society's president Russell W. Peterson mentioned Dick's classic bird guides, his activities as a founder of the Nature Conservancy, creator of many sanctuaries throughout the United States, and leader in many battles to save what remains of our national heritage. In his *Audubon Guide to Land Birds* Dick refers to the danger of the new insecticides, and rodent and weed poisons to all forms of wildlife. The possible resulting loss of the whole carnivorous community—songbirds as well as owls, foxes, and other animals—was a warning that Dick issued in his book published some 16 years before the publication of Rachel Carson's *Silent Spring*.

A letter from **Alden W. Peterson** refers to his attempt to track down **Alfred D. Petterson** who is listed in our records at Apt. 3G, 302 96th St., Brooklyn, NY 11209. Alden is still working for the city of Sturgis, Mich.

We talked today to **Dave Shepard** about possible plans for a mini-reunion to be held at the time of Technology Day activities. The class consensus favors having such an affair, probably in 1983 and centered at M.I.T.'s Endicott House in Dedham. Dave agrees and therefore your committee will set its sights on that goal. The class shares with Dave his sorrow at the passing of his devoted wife of 54 years after his return from the 55th Reunion.

Jim Killian sent a notice of the establishment of a career development professorship in chemical engineering in memory of **Ted Mangelsdorf** through the gifts of his son Frederick E., and the Texaco Philanthropic Foundation. Fred's two sons Theodore, Jr., and Frederick both attended and received master's degrees from M.I.T. in continuance of the traditions established by their father as teacher, member of the Corporation, president

of the Alumni Associaiton of M.I.T. and executive vice-president of the Texaco Corp. . . . **Al Ruff** in a letter to **Don Cunningham** explains his inability to attend the 55th. He and his wife were ill but they have both recovered as witnessed by their trip in October with a group of loyal York, Pa., people for a week in York, England. they also took side-trips, including tea with the Lord Mayor, and following that they planned to go to Helsingborg, Sweden, and Ireland for engineering services as a continuance of activities with clients since 1946.

The *Boston Herald-American* published an article and several photographs on October 2 in commemoration of the 80th birthday of **Stark Draper** with the comment, "For people who don't understand the first thing about science, there's only one way to regard Dr. Charles Stark Draper. With awe. Even people who understand quite a bit about science do that." . . . A recent note to the Alumni Fund from Ellen, widow of **Wallace W. Sanderson**, announces his death on May 7, 1979. The Institute of Electrical and Electronics Engineers has awarded Dr. **Peter L. Bellaschi** a bronze medal, certificate, and $1,000 for his outstanding contribution in the field of transmission and distribution of electric power. The Institute also published a bibliography of his distinguished career throughout the world as a consultant to utilities and industry, and as an author of over 150 technical papers and over 200 major technical discussions.—**William Meehan**, Secretary, 191 Dorset Rd., Waban, MA 02168

27 55th Reunion

At a meeting of our Reunion Committee on November 9, chairman **Ray Hibbert** reported the results of the class responses to date. We are glad the following are planning or hoping to attend: **Allen, Bearge, Burley, Coburn, Coffin, Cohn, Connell, Cunningham, Day, Decker, Drisko, Dyer, Edgerton, Emerson, Engel, Fisher, Franks, Grew, Hatch, Heins, Hibbert, Hurkamp, Johnson, Kaswell, Knowles, Leach, Lobo, Meytrott, Newell, Ordman, Parker, Peterson, Pope, Richards, Staples, Stevens, Sweet, Turner, Wies, Westerhoff, Willcutt,** and **Yates**. Most are bringing their spouses and quite a few are attending Wianno weekend only. Jean Arnold is contacting other widows with the hope that they will join us.

The following are excerpts from many notes received. **Lawrence W. Day** and wife Eleanor just celebrated their 50th wedding anniversary with all 13 children and grandchildren and about 40 friends at a dinner at the Country Club of Fairfield. Many toasts made a memorable evening. . . . **John B. Drisko** finally retired and says, "I can hardly wait" for our 55th. . . . **Carl H. Wies**, M.D., after interning and teaching at Yale, started practice in New London. While serving on the general staff in ETO Combat Intelligence Carl met several M.I.T. graduates and retired as a colonel. He then resumed medical practice and is still very active in medicine complete with house calls, etc. Carl also founded a whaling museum in New London called the "Tale of the Whale," which is an educational non-profit institution. He serves as its director and (I interpret) subsidizes the musuem as he built a replica of a beautiful Greek revival building.

Edward A. Leach has remarried and enjoys living seven and a half months in Springfield, Ill., and four and a half months in Palm Desert, Calif., with no more snow shovelling. . . . **Fred W. Willcutt** still keeps up his swimming, a half mile a day regularly for his health, as well as travel and working in his yard. . . . **Dwight M. Moore** made his first hole in one (171 yards), using Titleist DT-4 on the south course in San Diego on August 20. He congratulates Ray Hibbert on his second, and joins the club. . . . **Roger W. Allen** is still working part-time for Dilcher Engineering Co., in Atlanta.

Thomas A. Knowles took a short cruise to Alaska last summer and is living in an apartment in Naples, Fla., for the winter. . . . **Charles S. Pope** had open heart surgery in 1979, five pacemaker operations in 1980, and travelled to Greece, Turkey and Italy. In 1981 the pacemaker was working O.K., and he watched his son run the Boston Marathon. . . . **Gustavo Lobo, Jr.** and wife Vera, had a most exciting trip to mainland China in May with an M.I.T. group of which he was the oldest. He met with Chinese alumni in Shanghai and Peiping.

The **Milton Beargs**, moved two years ago to live near their grandchildren, luckily in sunny, southern (Torrance) California. . . . **Henry W. Newell** has lived in Frederick, Md., since retiring after 42 years with Turner Construction Co. "It's quite a dull life after all those years of building concrete buildings higher and higher. During World War II I was in charge of welding the T-2 tankers at Alabama Dry Dock and Shipbuilding Co. We put five of those out each month after a while." . . . **George M. Cunningham**, once again, performed the role of Andrew in "The Last Supper" at the Pageant of Masters at Laguna Beach for the seven weeks last summer, which involved 500 volunteers. Congratulations. George then left on October 8 for a three week trip to China and hopes to attend the M.I.T. Fiesta in Mexico City. . . . **Charles H. Hurkamp** is keeping his "alleged" mind active on consulting work for his son's company—Diversified Data Corp. "They use computers, but I was taught at Tech to use my fingers and toes and I still have all 20." **Theodore Ordman** retired from Kenyon & Kenyon and his practice of patent law after 40 years. On December 31, 1977, he moved to Duchess County where he and his wife enjoy rural surroundings far from the hurdy-gurdy of New York City, with full time to engage in his pet hobbies of horticulture and carpentry. . . . **Robert C. Wallace** will not be able to make the 55th because of wife Barbara's illness but is glad to donate slides of previous reunions to show. (We will show old slides for Friday evening at Wianno.) We will appreciate receiving them, Bob. Our best regards to Barbara.

We regret the delay in reporting the deaths of Dr. **Harold F. Hasse** on January 30, 1981, in Milwaukee, and **Robert U. Berry** on August 12, 1981, in Grosse Isle, Michigan.—**Joseph C. Burley**, Secretary Pro-tem, 5 Hutchinson St., Milton, MA

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A very welcome letter from **Alexander Daytz** starts off by explaining that he was inspired to write after just having read Class Notes in his copy of the *Tech Review*. (How about some more of you quiet ones getting similarly inspired?) We are sorry that Al's wife, Dorothy, died last March. Those of you who were at the 50th Class Reunion will remeber how we all helped Al and Dorothy celebrate their 50th wedding anniversary on campus. Although Al lives alone he keeps in touch with his son and daughter and is busy—especially with reading. In late summer of last year he took his grandson and grandson's wife to the Hawaiian Islands where they all had a wonderful time. Al hopes to be at the 55th in June 1983 but, in the meantime, would be pleased to see any classmates who may be visiting near San Diego. His address is in your 50 year Class Book.

A letter from **George Palo** says that the Palos had a successful trip to England. Then in October they traveled some in New England and managed to visit with Madeline and **Hal Porter**, Dorothy and **Herm Swartz**, and Alice Kirk. George reports that the upcoming 55th is now a general topic of conversation. . . . At a dinner for M.I.T. Sustaining Fellows on October 30 in Cambridge, '28 was represented by **Bunny Burnell, Jim Donovan**, Florence and **Walter Smith**, and Ruth and **Abe Woolf**. The dinner speaker was Vice President George Bush. . . . **Newton Foster** writes that he and Olive celebrated their 50th wedding anniversary in September 1980 at their lake community in Denville, N.J. Among the 109 guests were Gertrude and Henry "Nap" LaCroix. The Fosters now spend three or four months each winter at their campground near Flagler Beach, Fla.

With deep regret we must report the deaths of four classmates. **Francis B. Hart** died on July 20, 1980. We talked with his wife, Doris, by telephone and had a note from daughter Valerie. Bruce graduated in mechanical engineering, and was with Wright Aero Division of Curtis Wright Corp. during his years of professional activity. He served also in the Naval Reserve during World War II. Bruce liked to tell how he and Doris were married only an hour after he had graduated. They had a son (now deceased), a daughter, seven grandchildren and two great-grandchildren. . . . Col. **Vernon S. Brown** died September 9, 1981. Vernon graduated in mechanical engineering, and was a mechanical engineer for Stone and Webster and the Tennessee Valley Authority. Much of his active life was devoted to military service. Although a native of New England, he moved to Alabama in 1935 and became a thoroughly respected southerner for the rest of his life. In his home town of Florence, Ala. he was best known for his social service work and as an energetic participant in military and patriotic group activities. Besides wife Margaret, Vernon left a son, a daughter, and six grandchildren.

Thomas P. Howes, Jr. died September 4, 1981. Following graduation in business and engineering administration, Thomas remained in the Boston area and was active as an industrial engineer and consultant. . . . **Roger W. Purssell** died November 8, 1981. After graduation in electrical engineering, Roger did graduate work for his master's degree at the Institute then went to work for the Southern New England Telephone Co. He continued there until 1968 when he retired as assistant vice presi-

At the Alumni Officers' Conference last September two of our classmates were recipients of special awards. Irvine E. "Ted" Ross, Jr. '30, received the George B. Morgan Award for distinguished service as a member of the M.I.T. Educational Council. According to the citation his "warmth, enthusiasm and concern for individuals have promoted interest in M.I.T. far beyond what one might expect from a city the size of Fort Wayne . . . He has singlehandedly put Fort Wayne on the M.I.T. map." . . . Tony Savina '30, received the Harold E. Lobdell Distinguished Service Award. Tony's award was for his longtime services to the M.I.T. Club of Fairfield County, Conn.

dent. Roger was well known and well liked at his local M.I.T. Club (New Haven, Conn.). Besides wife Irene, he leaves son Robert who also graduated from M.I.T. ('66, physics). To the families of these classmates we extend our heartfelt sympathy.—**Walter J. Smith**, Secretary, 37 Dix St., Winchester, MA 01890

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Mary and **Frank Mead**, who live in Marion, Mass. (the Cape) from May through October and the rest of the time in Northport, Fla., write, "The news of Martha (Mrs. **Leonard C.**) **Peskin**'s passing made us feel sad. Lenney has been a generous and loyal member of our class for many years. With a few friends from our local golf club, we spent a month in New Brunswick, Canada, and in Labrador salmon fishing. We will be heading for Florida shortly and hope to see you there." Frank has been a most active and generous member of our class. He has participated in M.I.T. affairs regularly for the past 30 years or more, attending all the major five-year reunions and has been on the Executive Committee holding such offices as vice-president, president and class agent. He spent most of his professional career with the American and the New England Telegraph and Telephone Cos. in engineering, sales, rates financing, and marketing.

Hazen E. House of Knoxville, Tenn., writes, "I have been making things for the Association for the Preservation of Tennessee Anitiquities which are sold at the annual country market." Hazen holds membership in the following national societies: life fellow, IEEE; life member, ASME; and emeritus member, Sigma Xi. His hobbies are woodworking, metalworking, photography, and astronomy. He has two children, six grandchildren, and one great-grandchild. . . . **Donald S. Hersey** of E. Hartford, Conn., states that he has been gradually restricted to the more sedentary pursuits lately but manages to enjoy his hobbies, which include painting (art), playing the piano, bridge, gardening (flowers), and socializing with friends. He celebrated his 49th wedding anniversary with his wife Eleanor last October. . . . **J. Wesley Walters** of St. Paul, Minn. sends a brief note stating that he had a busy last week in June—Father's Day, his 76th birthday celebration, his 52nd wedding anniversary, and his daughter's birthday. He has two children, six grandchildren, and two great-grandchildren which keep him and his wife Josephine busy but happy.

I have a flattering note from **Amasa (Mace) G. Smith** of Birmingham, Ala., for which I am grateful, "Manage to keep busy, playing golf several days each week, sometimes with **Larry Luey**.I am still active on Community Chest, the United Appeal Board, and the Executive Committee. I am also with the Boy Scout Board, YMCA, and others. I still maintain an office downtown. Sara and the children are doing well, and we visit them in Atlanta and Clearwater (Florida) often. I am thankful to be in pretty good health, but this 75th birthday makes one feel older (darn it!). We enjoy your class notes in the *Review* and look forward to them. We are all indebted to you for your fine work as secretary. If you or any other member of the class happen to be in our area, you are all welcome to visit us at home." Mace spent all his professional career with the Chicago Bridge and Iron Co. of Birmingham, being shop superintendent, plant manager, vice-president in charge of area operations, and member of its board. He has been on the board of Associated Industries of Alabama, past president of Boy Scouts (Birmingham), Red Cross chairman, Jefferson County Community Chest chairman, United Appeal chairman, and director and president of the Downtown Club, Birmingham Country Club. He is also on the boards of Birmingham Trust National Bank, the Rotary Club (past president) and the National Woodworks. **William E. Lowery** of Plymouth, Mass., is involved with local government activities, being on the cable TV advisory committee last year. He also has been a town meeting representative since 1974. His hobbies include radio electronics and reading old books (those he missed in earlier years). He and his wife Charlotte have two children and four grandchildren.

John G. Howell of Piedmont, Calif., writes, "I am a consultant on a cogeneration study and I am facinated by its potential and I hope to develop further interest in other possibilities of applying this energy conservation concept. I am still involved in Children's Fairyland and our local schools. I am on a committee studying what to do with our City Hall and am very much interested in our Children's Hospital construction program as a volunteer professional. I have persuaded other retired professionals to join in and contribute their experience. We retired professionals still have something of value to give—our experience—which is more precious than money." John lists his hobbies as furniture building, house rebuilding, and civic involvement.

I regret to announce the death of Captain **James B. Magenis** on July 31, 1981. Marjorie, his widow, states in her note to the Alumni Association that "Jim was suffering from multi-factor dementia and stroke in the capillaries of the brain. After two months of illness, he wasted away. Fortunately, he did not suffer. He was always very proud and happy that he went to M.I.T." Jim was an airline pilot, having worked for Pan American World Airways, retiring in 1968. After retirement, he taught high school mathematics at Eastern Military Academy for five years.—**Karnig S. Dinjian**, Secretary, P.O. Box 83, Arlington, MA 02174

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At the Alumni Officers' Conference last September two of our classmates were recipients of special awards. **Irvine E. "Ted" Ross, Jr.**, received the George B. Morgan Award for distinguished service as a member of the M.I.T. Educational Council. According to the citation his "warmth, enthusiasm and concern for individuals have promoted interest in M.I.T. far beyond what one might expect from a city the size of Fort Wayne . . . He has singlehandedly put Fort Wayne on the M.I.T. map." . . . **Tony Savina** received the Harold E. Lobdell Distinguished Service Award. While I do not have a copy of his citation, it is probable that Tony's award was for his longtime services to the M.I.T. Club of Fairfield County, Conn.

Ralph Appleton retired about ten years ago as president of a real estate management co. in Columbus, Ohio, where he still lives. Since retirement he has made three freighter trips around the world on 12-passenger vessels, including a passage through the Strait of Magellan. He is a volunteer assistant at the Columbus Museum of Art. Ralph's wife Dorothy, Simmons '31, died about a year ago. . . . Supplementing last month's class note about **Charlie Abbott**, although retired Charlie is still a director of the Canal Electric Company which serves Sandwich, Mass.

Angelo Ricciardelli reports that four of the six Ricciardelli children are now self-supporting in various professions; only the two youngest are still in school. Youngest daughter Laura is a law student at the University of Richmond and youngest son Edward is a medical student at the University of Virginia. Understandably Angelo is one of the diminishing number of full time workers in the class of 1930; he works at the Army's Foreign Science and Technology Center in Charlottesville, Va. . . . **W. E. "Bill" Cullinan Jr.**, reports that he has retired for the third time. The organizations from which he has retired are in chronological order: the Federal Aviation Administration, manager of Logan Airport (Boston), and manager of airport services for E. C. Jordan Co., Inc. Bill lives in Cape Elizabeth, Me.

A delayed report has come in that **Cedric Roberts** died on May 2, 1981, in Mantua, Ohio where he had apparently lived essentially all of his life. The only information that I have in my records is a 1964 report from **Ralph Scott** that he and Cedric had worked together on an "Erie Railroad freight repair shop program at Meadville, Pa."—**Gordon K. Lister**, Secretary, 294-B Heritage Village, Southbury, CT 06488

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I haven't heard from a single classmate since writing the last Notes. If any of you would like more complete Notes, please drop me a line with information concerning yourselves, your family, and fellow classmates. Thanks to our Alumni Association, an article in the *Times-Argus* of Barre, Vt., of last September 14 tells of **Bill K. Bachli**'s appointment to the faculty of Vermont Technical College. Bill, according to the article, was an engineering consultant for four years and has 18 years of experience with firms such as General Electric Co., Dubois and King, Inc., Webster Martin and Sprague Specialties Co. He is also a registered professional engineer.

It is sad to report the death of **Franklin W. Zwicker** on April 3, 1981. Our sincere condolences to his family.—**Edwin S. Worden**, Secretary, P.O. Box 1241, Mount Dora, FL 32757; **Ben W. Steverman**, Assistant Secretary, 3 Pawtucket Rd., Plymouth, MA 02360; **John R. Swanton**, Assistant Secretary, 27 George St., Newton, MA 02158

32 50th Reunion

Ed Nealand reports that the 50th Reunion committee is in its final stages of planning a gala long week-end with all kinds of exciting features. Many more than the 165 projected will attend our reunion. Many will come as practical strangers wondering how they will fit in. Be assured that you will meet old friends and make many new friends. Don't hesitate! Come!

Stuart D. Miller although retired is a very involved person. He and his wife do volunteer work for his church and hospital. He enjoys his wood working shop in the basement. . . . **Joseph Friedman** is still doing consulting work. About a year ago he visited mainland China. . . . Professor **Carroll L. Wilson** makes the news again. This time he has won the John & Alice Tyler Ecology Energy Prize ($100,000). He has organized leaders in industry and government of a dozen countries to work as a team to seek solutions to world energy and environmental problems.

Jack Stover writes recalling his school memories of his friend **Albert Dunning** and also the Navy years with his older brother Allan, who held a responsible naval construction position. Jack would like nothing better than to attend the 50th however he believes his health will not permit him to do so. Jack, I hope you do make it and can greet your friends personally.

I have **Wendell Bearce** to thank for information about **Stillman Haynes** whose wife died last year; they were married in 1938. He has three children and three grandchildren which are a great comfort to him. Stillman worked for several large corporations over the years and retired from Mobil five years ago. He likes to take long walks and travels when he can. He lives alone and doesn't care too much for housekeeping. He hopes to come to the 50th. He says his friend and classmate **John Kelly** would like to go to the reunion but Parkinson's disease will probably prevent him from doing so.

With sadness I report the death of **Louise Rousseau** in September 1981. She was a most colorful personality doing many unusual activities in addition to being an airplane pilot. She did radio scripts for the Lone Ranger, and gave legal help to those screen writers and producers implicated in the black listing era in Hollywood. She was a devoted animal lover and did tireless work for many Humane Societies.

I must also report the death of **Henry A. "Hap" Phillips**, on August 2, 1980. He lived in New Hartford, Conn., for 36 years and was the deputy manager for the Metropolitan Water Bureau retiring in 1976. He worked for the Masons for many, many years and received all kinds of honors and prizes for meritorious services. He leaves his wife Thelma, two sons, two daughters, and 11 grandchildren. **Melvin Castleman**, Secretary, 163 Beach Bluff Ave., Swampscott, MA 01907

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Banner headlines this time are furled unanimously for our own mechanical engineer, **Ralph E. Cross**. The Ralph E. Cross Senior Lectureship and the Ralph E. Cross Fellowship have been established in the Laboratory for Manufacturing and Productivity, in honor of Mr. Cross, through whose generosity the Lab has already established new research efforts in productivity analysis techniques, laser micro-machining and robotics. The first series of lectures, to be held in January, will be given by the three holders of the Lectureship, to be named later. The current Ralph Cross fellow is Randolph Andrews of Greenwich, Conn., a graduate student now working with Professor Neville Hogan in the robotics field.

We have what I must call a Christmas card from **Walt Skees**, presently of Barcelona, Spain. I do have Walt's address for anyone interested.

I have been going through the usual medical examinations where the M.D.'s study us in the hopes of correcting a noticeable heart weakness. It has meant, for me, three weeks in the hospital where the fellows study an irregular heart beat. They finally decided on the insertion of a pacemaker, which appears to be turning out quite well. This, I hope, will explain my real reasons for turning down an opportunity to solicit funds for our 50th Reunion Gift—I was forbidden to participate in any such endeavor. With Class Notes so brief these days, they agreed to allow me to continue with them. So far as I know, I now carry on as before. I am curious to know how many of y'all have pacemakers.

For the first time in my lifetime as Ye Scribe, I have received not one direct message from any classmate for use in this issue. However, we do have two life savers in the form of Alumni Fund envelope notes, thank heavens. From **James H. Merritt**, "Retirement continues to be enjoyable. I find a myriad of activities keeping me so busy I wonder how I found time to go to work." Perhaps, Jim, your present activities come out of different boxes. Thanks for the fine note.

The other timely correspondent, **Bernard Lapidus**, M.D., is one of our rare characters who took a bachelor's degree with us then started out right away and got into medicine, where he appears to have belonged in the first place. He writes, "Little to report from Columbia, S.C., where I am retired from service as a gastro-enterologist at the local Veterans Administration hospital, and as medical consultant to the South Carolina Vocational Rehabilitation Department disability determination division. Right now backyard fishing is real slow, but bound to pick up." Haw!! This fellow has been known to a lot of us, including me—Bernard, you must have done well in your chosen profession. We are all proud of you.

It is fortunate that we have but one of ours who has passed away, Alfred W. Garnell. Alfred held a master's degree from Course I and was in the manufacture of furniture in Rhode Island, where he did very well, I hear. . . . That covers all I have this time. Please note again that each and every one of you sent Ye Scribe no message at all for this issue's notes. Perhaps you have all been busy sending in checks for the 50th Reunion Fund. With approximately 17 months to go before June 1983, there will be 11 issues of the *Review*, including this one when 50 rolls around. If anyone can write one letter, please send it to **Dayton Clewell**. I missed the usual year end greetings, so I must now ask your pardon. May the rest of your new year be happy.—**Warren J. Henderson**, Secretary, Fort Rock Farm, P.O. Drawer H, Exeter, NH 03833

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This month almost all the good news comes from Alumni Fund notes, of which I have several. The first, from **Edward S. Fleming**, Captain, United States Navy (retired) says, "After retirement from the Navy in 1961, the demand for Course XIII types was pretty low! So I went to Puerto Rico to help build a small ship repair facility and got into the construction and development business. After five years in Puerto Rico I worked in the Boston and Washington areas until 1977 on all types of commercial and residential projects. In 1977 I left Washington and built my present home in Gettysburg. I have been appointed treasurer of the Lake Heritage Property Owners' Assoc., and I enjoy my solar green house, garden, round dancing, and have philatelic interests. With sorrow I learned of the recent passing of **Bill Baker**, and earlier of **Sim Jester**, both of Course XIII. I would enjoy an update in the Notes of other XIII and XIIIC classmates." Well, you naval architects and marine engineers—heres your chance. Tell me what you're doing and I'll see that everyone gets to read it.

G. M. "Billy" Woodman writes, "Last May my wife Audrey and I attended my 1931 class 50th reunion at Bowdoin College. We had a wonderful time and hope to be able to take in the 1934 class 50th at M.I.T. in 1984." Seeing the year of our reunion in print makes me think that maybe the reunion souvenir should be a copy of George Orwell's book!

Life seems to have its problems for **Bill Coleman** who notes, "Both myself and my wife, Pat, have been in the hospital for operations this year. We're doing O.K. now but are finding the cost of living a problem. Property taxes are going out of sight with increases of 50 to 75% this year. We still like Florida, though."

The last is from **Herb Andrews** who says, "Thank you for your sympathetic note in *Technology Review* Class Notes. I am sorry to say that Blanche, my wife, died at home on September 15, after seven months in bed during which I cared for her. She was beloved by her family and friends. I am managing to keep busy." I am sure we all sympathize with Herb in his loss—I think these protracted illnesses are so hard on both the patient and those who have to look after them who, at the same time, keep up a good face.

Unfortunately there are also losses of classmembers to report. **George F. Koller**, of Newton Upper Falls, died on October 10 at the age of 71. He was the founder and president for 25 years of Koller Associates, Inc., an architectural and engineering firm. Previously he had worked for 17 years as an engineer for Shell Oil Co., and from 1955 to 1975 he was an adjunct professor of business management for Babson College. Mr. Koller was a violinist and soloist with many community orchestras and choirs, a scoutmaster in Newton, and active in the Masons. He is survived by two sons, Thomas T. of Holliston and John D. Koller of Rochester, a sister Helen in California, and three

Join us for a lively discussion on future developments in communications technology—"Alexander Graham Bell, What Hath Computers Wrought?" Leaders from M.I.T. and industry will provide direction for adapting to the changes in our personal and professional worlds on Technology Day, June 11, 1982.

grandchildren.

Our other loss was that of **Cecil Faroni** who was living, at the time of his death, on August 24, in Boca Raton. In a note advising the Institute of his death his sister, Mrs. Mary Faronia Venezia, said that his death was sudden and that "M.I.T. was very dear to his heart through the years." To both families I would express the sympathy that I know we all have for these losses.

I have been engaged in correspondence for some months—even air mail letters to Argentina take time and my answers take longer—with **George Huff** who is living in Mercedes in the Province of Buenos Aires. He had spent one year at Tech and went on to get a bachelors in mechanical engineering at New York University. However, he retains a great interest in his conneciton with M.I.T. and has promised to send me some notes on his career. The 1975 Alumni Register lists him as a naval plant representative at Grumman on Long Island.—**Robert M. Franklin**, Secretary, 620 Satucket Rd., P.O. Box 1147, Brewster, MA 02631; **George G. Bull**, Assistant Secretary, 4601 N. Park Ave., Apt. 711, Chevy Chase, MD 20015

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I'm delighted to pass along to you a letter I received from **William J. Bates**, now of 9A Gateway Towers, Pittsburgh, PA 15222. "It's been some time since I've been in touch with you and as I read your report in the October *Tech Review* I got the push to drop a line and say hello. As you remember I retired from U.S. Steel in February 1977, and started a management consulting business on a small scale. I've also been doing some industrial marketing research for a Pittsburgh firm. As if this didn't keep me busy, I'm the western Pennsylvania representative for the International Executive Service Corps (IESC) for which I spent 1978 and 1979 in Mexico. At the same time Dick Bell, '34, was also there for IESC and since he now has a ceramics plant near Pittsburgh we see each other frequently. Last spring we spent three months in the West Indies for IESC—a great place to be from February to April. I married again in July 1979 and took my bride back to Mexico. (My first wife had died in 1975.) Haven't had much time for golf and I think I like **Ham Dow**'s approach to playing for fun; I just seem to have too many things taking my time. We sold our house at the end of June and went through a mad scramble clearing things out and getting settled here in a condo in downtown Pittsburgh."

Here's my annual message from **Art Haskins** via the Alumni Fund Office: "I just hauled my boat for the winter and laid down her mooring. Now I am putting on the winter cover, reconditioning and stowing gear. When the boat work is completed, I'll start some of the jobs around the house that I put off all summer so that I could go sailing. Besides boat work and sailing this summer, I painted our church with some of the other members, then ran out of time and had to get my own house painted by a pro. Like a lot of retirees, I'm not getting as much done as I had expected to do, but I suppose that it's due to my taking my time and enjoying what I'm doing."

Picture **Bud Pflanz** sitting in his den listening to his 20 channel scanner with his right foot propped up on a pillow and writing this letter: "Being a nice guy and a neighborhood handy man I overdid my act and had a ladder slide out from under me. Thought I bruised a couple of toes, etc., but 19 days later, as it was still swollen, I went to the doctor and was told I had five broken bones—toes two, three, four and two more in the ball of my foot. Yup, the right foot, so I can't drive, hence am on Downtime—down to my last bottle of scotch, my last fifth of martinis and my last frozen steak. Most of my summer was spent in reassuring my son David that he had recovered sufficiently to return to college and resume his formal education. It wasn't easy to do and we spent many long hours together but he returned to Arizona State in Tempe. A local friend drove out with him and saw him safely billeted where a classmate took over. His past memory has returned (about 95%) and his present day sequential memory is only about 50-70% functioning but will improve with constant mental exercise. His physical condition is improving—he now can keep his balance and ride a bicycle. In short, each day he improves a wee bit more. I plan to go west over Thanksgiving to Sierra Vista, Ariz., where number two daughter lives; David will come east the 180 miles to be with us. My number one daughter, Nancy, can't make it there from Albuquerque because some 6'4" red bearded viking is taking her skiing. As for me—on October 30 I hope to see my toes again—off with the cast."

I am already over my allowed space for notes so I am going to save a letter from **John Mooring** to Bud Pflanz for the next issue (it was also directed to **Bill Parker**, **Charlie Debes**, **Otto Zwanzig** and **Trow Leavitt**).

I am sorry to have to tell you of the deaths of three more of our classmates: **Horace B. Gulden**, course X died on June 2 in Lewistown, Pa.; **Allen E. Beckwith**, course X, Boston University professor emeritus died in Boston on September 24; and **Charles P. Bowen, Jr.**, course X, honorary chairman of Booz, Allen & Hamilton died September 17 in Greenwich, Conn. I am extending our deepest regrets and sympathy to their surviving family members.—**Allan Q. Mowatt**, Secretary, 61 Beaumont Ave., Newtonville, MA 02160

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On a sad note I quote from a letter from **Dana Devereux** received in mid-November. "I have just learned that our classmate, **Bill (William P.) Canning** died in his sleep about a month ago. He had been having some heart problems. He was semi-retired, doing an occassional consulting job for the firm of Bavier, Bulger and Goodyear. They considered his mechanical engineering skills to be truly outstanding." Follow up by phone produced from Dana the information that Bill was a widower and leaves a son and daughter.

Eight classmates and spouses turned up in West Hartland on the 24th of October. Present were Pauline and **Kenneth Arnold**, Mary and **Fred Assmann**, Kitty and **Herb Borden**, i and **Eli Grossman**, Rilla and **Walt MacAdam**, Virginia and **Augie Mackro** (who were responsible for the organizing), Lillian and **Larry Peterson**, and Phoebe and **Frank Phillips**. That day was the Petersons' 40th wedding anniversary and the occasion was appropriately celebrated. The food - all brought by others - was superb and I had a wonderful time!

Continuing my inverse alphabetical report on the Reunion Biographical Information: **Mike Tremaglio** reports from nearby Waterbury, Conn., that he has spent most of his time since graduation in a family owned building engineering firm which has constructed hospitals, post offices and commercial buildings, largely in the Northeast. He and Edith are proud that their son Richard (I-A, '68) is a professor in the school of architecture. . . . **Fletch Thornton**, our indefatigable 45th Reunion chairman, retired to New London, N.H. from New Jersey where he spent many years as president and chairman of Thornton Assoc., Inc., manufacturers sales agents. He says that his highlight started in 1956. "On Election Day in November 1956, the voters of Summit, N.J., faced an array of names under the levers, among which in the upper left-hand corner was Dwight D. Eisenhower. . . way over at the right could be found the name of Thornton running for member of the Common Council." In his district he received more votes than Ike did! "The result was seven years on that council, four as its president, and an unbelievable postgraduate course in municipal law. Being a big frog in a little pond can be an exhilarating experience, if one can keep firmly in mind what size frog he really is." The photo shows Fletch holding his twin grandbabies.

Gordon Thomas, now retired and living somewhere east of Newport Beach, Calif., writes, "Providing chemical engineering and construction services internationally has dominated our lives and provided an endless variety of good living. Managing the birth struggles of these big plants has generated great professional fulfillment. There they sit, and you did it!" Now the Thomases are adjusting to retirement. We'll be glad to hear more. . . . **Ariel Thomas** as senior vice president of Metcalf and Eddy, Inc., Atlanta, has travelled on business and for pleasure. The most interesting was a tour of Egypt, Jordan, Israel, Cyprus and Greece. He comments in passing that the first names of members of his family all commence with "A": wife, Avis, daughter Ann, son-in-law Alan, and granddaughters Amy and Alice! . . . **Winthrop Stiles** has retired to Titusville, Fla., after serving as chief engineer of capital development at A.I.D. Afghanistan. His work has meant residence in Africa, the Middle East and Far East for the past 17 years. He retired in 1974 as a captain in the U.S. Navy. . . . **Donald Spencer** went on to earn a Ph.D. and later an Sc.D. from the University of Cambridge, England. He has retired to Burango, Colo., from his job at Princeton University where he held the Henry Burchard Fine Professorship in Mathematics. . .

Art Sarvis writes from Flint, Mich., that he has retired as a specialist in employment relations. He holds an MBA from Chicago and worked for Allis Chalmers for six years and General Electric for 22. he spent three years in the Air Corps in World War II and nine years as a business consultant. He keeps busy with sports and investment analysis. .

. . More in the next notes.—**Alice H. Kimball**, Secretary, P.O. Box 31, West Hartland, CT 06091

37 45th Reunion

On October 5, 1981, seven members of the Reunion Committee, **Dick Young**, **Phil Dreissigacker**, **Bob Harris**, **Les Klashman**, **Bob Thorson**, **Ralph Webster**, and **Phil Peters** met at Phil's home in Wellesley, to plan our 45th Reunion. When you read this in February, you will have received Dick's first letter and possibly a second. We do hope you all plan to participate June 7, 8, and 9 at the Harbor View Hotel on Martha's Vineyard (in Edgartown, Mass.) and then back to Cambridge for cocktails and Tech Night at the Pops. MARK DOWN THE DATES—WE WILL SEE YOU ON MARTHA'S VINEYARD!

Ed Corea, 14 Main St., Hingham, Mass., keeps busy in his retirement by continuing his volunteer work at a local nursing home. In addition he is helping others to cut fuel bills by reducing heat loss in their homes. He has become knowledgeable about insulation, solar heat, and caulking. . . . **Lester Klashman** continues in semi-retirement doing occasional consulting in environmental engineering. During last year he did some work for the U.S. Environmental Protection Agency, Office of Inspector General in New Jersey, Virginia and metropolitan Boston. His oldest grandson, Robert (18), is a freshman at Brandeis University and his daughter Martha lives in Peabody with her two other children, Mark (10) and Michele (15). With Pearl, his wife, he gained two stepdaughters: Emily Pearlstein who is a pre-school teacher in Newton, Mass. and mother of James, age one and a half and Sarah, age seven; and Sue, a graduate of Stanford Business School and a consultant in fiscal management and human resources with Harbridge House in Chicago, Ill. Since retiring as a social worker with the Big Sister Assoc. Pearl keeps busy helping family and friends. They spend two months in the winter in Del Ray, Fla., walking, swimming and sailing.—**Lester Klashman**, Assistant Secretary, 198 Maple St., Malden, MA 02148; **Robert H. Thorson**, Secretary, 506 Riverside Ave., Medford, MA 02155

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Cliff Nelson reports that he and Jane attended a conference on computers in cardiology in Florence, Italy last fall. Cliff plans to retire officially this June, but will continue working in the research department of Maine Medical Center. As he puts it, living in Maine, who needs to retire? Hams may contact Cliff at W1JDA.

While Sandy and I were driving in the rain last fall in Scotland, Wales and England, Jean and **Ed Hadley** were on a whirlwind tour of mainland China, leaving son Peter '65 in charge of the house. In Shanghai Ed tried unsuccessfully to contact our three classmates there, but had to content himself with sending them copies of his masterwork commenorating our 40th Reunion, "'38 in '78." After seeing the Great Wall, they returned to Seattle for a week with son George '65 and thence home. Ed also reports that he is now a student at the little red schoolhouse up the river, where he is taking four courses in thier Institute for Learning in Retirement.—**Armand L. Bruneau, Jr.**, Secretary, 663 Riverview Dr., Chatham, MA 02633

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Jack Hamilton and Joan visited one of their daughters in San Diego, and we lunched near the famous La Jolla Beach and Tennis Club. Incidentally, Jack and Joan play tennis every day. Repeat: *Every Day*! Jack was with Alcoa for his full career, the last 11 years of which, before retirement, were as president of its Wearever subsidiary. At lunch Jack and I did not discuss aluminum pots and pans, but Jack did recall an undergraduate adventure with **Hans Bebie** when both were in New York City seeking championships at an NCAA track meet. It seems Hans had a bit of a problem getting his pole (for pole vaulting) through subway turnstiles near Times Square. Years after that Jack spearheaded a unique adventure as Wearever successfully met its challenge to compete against cost-cutters. His whole Pennsylvania community benefitted and applauded; the episode made national headlines. The United States' auto, steel, rubber, and glass industries might, if they were equally skillful, take a page out of Jack's book of achievements.

Art Zeldin writes from Salt Lake City that he has discontinued fulltime work as vice president of materials management for Kennecott Minerals Co. to consult in metallurgical operations.

John Dodge writes from Wayne, Penn. that he has transferred consulting thrusts from the U.S. Department of Defense to the operations department of his boat. Could be, John, that one change of this will be in the speed with which visible results will appear.

Please note my new address. It's about three miles east of the old one and affords an even more spectacular view.—**Hal Seykota**, Secretary, 1603 Calle de Primra, La Jolla, CA 92037

40

An interesting letter from **John Casey**, chairman of Braniff Airlines indicates that he is somewhat disturbed about you fellows who are thinking of retirement or, " . . . leaving the fray of battle just when things are reaching the most exciting pitch." From the press it would seem that he has been in the battle and come out as the hero, having persuaded the president of Southwest Airlines, who had been most successful in this position, to defect to his side. We wish you continued success, John, in your effort to get Braniff to really soar.

A feature news article tells about **Leonard Weaver**'s extra-curricular activities as director of the Neponset Choral Society. You will remember him as a member of the M.I.T. men's glee club. Garrett reactivated his company's glee club after World War II, nurturing it into a non-profit organization of 75 singers from 20 area towns. His 33 years on the podium will end this May with a performance of Gilbert and Sullivan's "The Gondoliers." This will coincide with his retirement as manager of the technical center of Bird and Sons, Inc., Walpole, Mass., after more than 40 years of service.

A recent news clipping indicates that **W. H. Krome George**, chairman and chief executive officer of Aluminum Co.. of American, has been elected to the board of International Paper Co.

There's more sad news to report on the death of two of our classmates. **Marshall E. Greenspon** of Silver Spring, Md., died on October 22, 1981, at the Washington Hospital Center, Washington, D.C., from cancer. Marshall moved to the Washington area in 1941 and worked for the old War Department. During World War II, he was a naval officer, serving in the Pacific. He returned to work for the Navy, NASA, and an architectural consulting firm before joining the Washington Metropolitan Area Transit Authority in 1971. He retired from this position shortly before his death.

James R. Gilman passed away suddenly on June 13, 1981, at his home in Framingham, Mass. Jim had been director of quality control and industrial engineering with the Bay State Abrasives Division of Dresser Industries, Westboro, Mass. In addition, he had served as commissioner of the Massachusetts Board of Standards, State Building Code Commission and helped write the building code for the state. He lectured extensively on quality control, product liability and a variety of technical subjects relating to grinding wheel manufacture.

Ed Bernard indicated that as of November 10th (when we went to press) 164 members had paid their dues, and were therefore in good standing. your class annual dues will help make our 45th Reunion a great affair. If you have not yet forwarded your check for $5.00 to Ed at 57 Winn St., Belmont, MA 02178, please ante up. . . . News items are welcomed. Can I hear from you?—**Donald R. Erb**, Secretary, 10 Sherbrook Dr., Dover, MA 02030

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George W. Clark, manager of technical liaison at GTE Lighting Products has been awarded the 1981 Gold Medal from the Illuminating Engineering Society of North American. George is a past president of IES and has been with GTE over 33 years. He has perceived the need for information on the photobiological effects of light and outstanding achievements in a wide range of technical, management, and liaison assignments. George and his wife live in Topsfield, Mass.

Les Corsa writes that he has just returned from a "great four months in rural China studying their birth control program, which really works." Les' U.S. Congress Office of Technical Assessment report on "World Population and Fertility Planning Technologies" was to have been issued last November. Les hopes "that Congress gets the message that world population growth is far from under control and that congressional actions now have tremendous long term effects."

Your secretary has been elected the vice chairman of the American Defense Preparedness As-

George Clifford (left) and Marty Billett (center) join Harry Ottobrini for an afternoon sail in Boston Harbor—a very mini Class of 1948 reunion.

soc. This is a 32,000 member national organization which was founded in 1919 and is dedicated to national preparedness.

Knut Johnson is retiring from PPG Industries. . . . **Quentin Wald** who is with the Electric Boat Co. is active in the Old Lyn Tax Payers Assoc.—**Henry Avery**, Secretary, Avery Business Development Services, 440 Totten Pond Rd., Waltham, MA 02154

42 40th Reunion

If you have not already done it, today is the day to get in your reservations for our super 40th Reunion from June 9 to June 13. We will be on campus on June 9 and 10 and have reserved the Wychmere Harbour Club in Harwichport on the Cape from June 11 to 13. . . . I just spoke with **Carl Zeitz** and he tells me that all of you who were at Wychmere at our last reunion will be amazed at the new construction, improvements and facilities since that visit. Additional tennis courts have been built and, of course the excellent golf course is right near by. Don't wait, save the date, and get your reservations in to Bob and Carl now!

A note from **George Watters** tells us that he has been living in a four-story townhouse in London for the past two years as chairman and chief executive of Amoco Trading and Shipping Co. This part of the Amoco organization is responsible for all of the company's crude oil acquisition, trading and sales activities in the Middle East, Europe, Africa and in the Far East. George has been averaging about two plane trips a month and I'm sure is happy that there is not an air controllers strike on his "beat" as we have over here.

Lou Rosenblum sent a very interesting "commercial" on the Graphic Arts Research Foundation (GARF) sinotype input terminal. The terminal is run on an Apple II micro-computer and is the data base of more than 6,000 Chinese characters and more than 24,000 input code descriptors. . . . I just got a full-page, three column feature on **Charlie Smith, Jr.**, complete with a big picture of him in a hardhat, standing in front of bins and bins of Sifco Industry's forgings. Smitty is still the United States employer delegate to the United Nations' International Labor Organization and is busy with his company's domestic and overseas affiliations with forging companies in Japan, Argentina, and India.

Writing this in November so that by the time you read it I can express our very best wishes for a Happy Holiday Season and great 1982!—**Ken Rosett**, Secretary, 191 Albermarle Rd., White Plains, NY 10605

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This would be a very abbreviated column if I had not tapped other sources besides the mail. The telephone still works so I was able to stir up some hitherto dormant classmates. Shortly after our 25th Reunion, **Carl Bryant** and his family lived for two years in France before returning to the U.S. They now reside in Camden, Me., where Carl is a naval architecture consultant specializing in LNG tankers. As a sideline, he and his wife Betty run a Hallmark card and gift shop. Son Carl III, M.I.T., '67, lives in Wellesley and daughter Susan is a lawyer in Norman, Okla. (cheers). Another daughter lives in New York, but happens to be a graduate of Oklahoma University (more cheers). Carl and Betty have three grandchildren and say if your're ever in Camden, drop in and buy a greeting card.

Reginald C. (Chip) Fisk is a partner in a small diamond tool business in Marlboro, Mass. He has a Ph.D. daughter in Phoenix, working in adult education and his son is located not far away in Massachusetts, toiling for a computer firm. Chip used to be an avid baseball fan, but 1981 has brought him great disappointment. He yearns for the golden days of the Red Sox and them bums at Ebbets Field.

Jim Houser is enjoying retirement after 34 years with Martin-Maretta (aircraft, not cement plants). He is mayor of Maitland, Fla., a suburb of Orlando, where he is also involved in the management of some shopping centers. Jim has two children and seven grandchildren. . . . **Harry Ottinger** was astonished that I had traced him to Albuquerque, where he retired five years ago from Exxon. Harry was once a chemical engineer, but he now makes custom furniture with the help of his son. I think he must also have an interest in a motel, because he has invited all his classmates to visit him.

I enjoyed talking to these gentlemen on the phone, but it's a desperate resort to fill a column. Please send in your news.—**Bob Roschach**, Secretary, 2544 S. Norfolk, Tulsa, OK 74114

44

Spring is coming! It always does, but some years it seems to take longer than others to arrive. . . . **Robert H. (Bob) Horsburgh** writes from Fremont, N.H., that he is "consulting in management and public relations."

A half-page article in the *Times-Argus, Barre, Vt.*, August 24, 1981, is devoted to the beginnings and current success of Vermont Research Corp. **Hugh M. Taft**, president of the memory drum manufacturing firm, tells how the company got started, found local financing, and has continued to grow since its start in 1960. This fascinating story could be included in a book of companies started by M.I.T. alumni.

How to have your cake and eat it too: Your secretary attended a luncheon at the Faculty Club when Thomas R. Henneberry, associate director of the M.I.T. Office of Planned Giving, went over the various life income plans available through M.I.T. Their credit to your 40th reunion giving, plus tax deduction, plus life time income sounded most appealing. A call to (617) 253-3827 will bring more details.

From *Tech Talk*, "Echoes, 40 years ago": "A dining system started just a few weeks ago in Walker...waiter service has replaced the cafeteria rush, with checks presented at the end of the meal...music is played throughout the dining hours..."

Our condolences to the widows and families of **Richard V. Hatfield**, naval architect, transportation economist and management consultant, and former vice president of Booz-Allen, who died on July 24 in Sarasota, Fla.; and to **Alfredo Lamela** and **Carlos Voulminot**, whose deaths were reported by the M.I.T. Club of Uruguay to have occurred during the past year.—**Melissa Teixeira**, Secretary, 92 Webster Park, West Newton, MA 02165

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During the class reunion in June, **Jim Ray** advised that he would be happy to assume the duties as secretary in the future, if I ever felt I would wish to relinquish them. I have thought about his suggestion during the past four months and have decided that I should let someone else have the opportunity to be the class secretary. I have held the office since the 15th reunion at the Snow Inn, and that is long enough for one person, and I feel others should be given an opportunity. Therefore, beginning with the April 1982 issue, Jim Ray will become secretary of the class of 1940. Please mail information to: James C. Ray, 2520 S. Ivanhoe Pl., Denver, CO 80222.

It was wonderful being the secretary for these past years, and I wish to thank all of you who have written us in the past. I know you will give Jim your wholehearted help.—**Russell K. Dostal**, Secretary, 18837 Palm Circle, Cleveland, OH 44126

47 35th Reunion

Save these 1982 dates: June 10, *Tech Night at the Pops*, and June 11, Technology Day, plus before and after for our own gala reunion activities.—*F.H.B.*(**Virginia Grammer**, Secretary, 62 Sullivan St., Charlestown, MA 02129)

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After tallying the results of the fall upgrading telethon the Alumni Fund presented the "Bronze Phone Award" to our class for its outstanding work in the telethon. Nine members of our class spent an evening making phone calls to other alumni to thank them for their previous support and to ask them to consider an increase in this year's gift. The callers were: **Carl Accardo**, **Bob Bliss**, **Dave Brown**, **Leon LaFreniere**, **Sonny Monosson**, **Malcolm Reed**, Jean and **Milton Slade**, **Graham Sterling**, and yours truly. The award was based on the cumulative success of our callers compared to other classes. I was the class telethon coordinator who called the callers and asked them to call. During the week of October 26, 100 callers (including our nine) called 1712 alumni and obtained 420 upgrades.

John Randolph was recently elected to the board of directors of Data Switch Corp. John has an extensive background in the data processing industry, particularly in the area of lease financing. In 1965, he formed Randolph Computer Corp., one of the first and most successful leasing companies in the computer industry. They became a public company and eventually the assets were

Albert E. Cookson, '51 (center), senior vice-president and general technical director of ITT, presents a check for $100,000 to Paul E. Gray as part of the corporation's gift of $500,000 to support the ITT Career Development Professorship in Computer Technology. At left is Joel Moses, head of the Department of Electrical Engineering and Computer Science. The ITT Career Development Professorship in Computer Technology will provide important support for promising young faculty members in the department, M.I.T.'s largest with more than 25 percent of the enrollment of the School of Engineering. Dr. Cookson, a world leader in the design, production, and sales of telecommunications and electronic equipment and systems, has had a long association with M.I.T. (Photo: Calvin Campbell)

acquired by First National Bank of Boston. John ran the company for the bank through 1977. In an industry noted for major busts and near collapses, John is proud to say they were always highly profitable. John wrote me to say that currently he is in academia. First, he is pursuing a master of arts degree in humanities at Manhattanville College. And second, he has taken over the development and alumnae relations functions at Greenwich Academy, a girl's school that goes through 12th grade. He and his wife Kathleen live in Greenwich, Conn., with their two children.

Steven J. Miller has returned to Los Angeles and is with Data Resources, Inc., the leading economic consulting and forecasting company, as director of marketing for the Los Angeles region. . . . **Richard H. Gaunt** has retired to Florida and loves it! . . . In September **Harry Ottobrini** arranged an afternoon sail in Boston Harbor. George Clifford and I joined Harry for three hours of exhilarating tacking and jibing as we kept a 39 foot boat within the deep water channel along with two cargo ships and a coastal tanker. Harry has extensive cruising experience in the Caribbean where his yacht is on charter. Harry has diversified his portfolio to include a manufacturing company and real estate in addition to securities. He and Eleanor have a ski lodge at Killington, Vt., and they have vacationed in Europe. George is responsible for international marketing at the medical products division of Corning Glass. One of the products of that division is the instrument that George developed and marketed when he has his own company before he sold his business to Corning. Our photo was taken by George's associate from England who handles the marketing of Corning's products in the United Kingdom.—**Marty Billett**, Secretary, 16 Greenwood Ave., Barrington, RI

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Tom Lamphier, has retired from the presidency of the transportation division of Burlington Northern. He is "now working, at my own pace as a transportation consultant, and doing some writing about the transportation industry."

David L. Bailey has been appointed technical director of MITRE's air transportation systems development division. Dave was a staff member at Lincoln Lab before starting with MITRE in 1959. . . **Gene Wroblewski** reports the death of our classmate **Willian Balas**.

Frank M. Anthony is chief engineer of tank and structural development at Bell Aerospace Textron. He was presented the prestigious Aerospace Pioneer Award by the Niagara Frontier section of the American Institute of Aeronautics and Astronautics. His award was for "notable and pioneering contributions, particularly in laser mirror technology and the development of an advanced heat exchanger concept."

Please include personal notes on your Alumni Fund envelopes, or drop a note directly to my house. This column is the best way to keep you and your contemporaries aware of class activities.—**Paul E. Weamer**, Secretary, 331 Ridge Meadow Dr., Chesterfield, MO 63017

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Donald A. Harnsberger resigned from Cooper Industries in July of 1980 after having spent 16 years in Europe (England and Germany) and the U.S.S.R. He has moved to Princeton, N.J., to join the Plasma Physics Laboratory as resident engineer on the TFTR fusion complex, which is scheduled for completion in 1982.

Joseph B. Oppenheim went on a pilgrimage to Israel and London in May of 1981. . . . **Frank M. Calkins** visited M.I.T. in June of 1981 to see his oldest son, Charles, graduate in course X. Frank and his family were the first to stay in Baker House during the year 1949 to 1950. . . . **Harry Tecklenburg, Jr.**, senior vice president of Proctor & Gamble Co., in Cincinnati, is assuming special staff responsibility for the future worldwide disposable diaper product development, engineering, and manufacturing.

Kenneth Eldred has announced the establishment of an engineering firm to provide consulting services in acoustics and vibration. Ken Eldred Engineering specializes in evaluating and finding practical solutions to problems, with emphasis on environmental noise both in the community and the workplace. Ken has been with Bolt Beranek & Newman for the past eight years, where he served as a vice president and director of the architectural technology and noise control division, and as a principal consultant. His prior experience includes: vibroacoustic research and consulting for the space program and others at Wyle Laboratories; general consulting in architectural, environmental and aerospace acoustics at the Western Electro Acoustics Laboratory; research in airport, aircraft, and rocket noise and in human response at the USAF Aeromedical Laboratory; and diagnosis and solution of shipboard and submarine sound and vibration problems at the Boston Naval Shipyard. He is active on many standard committees and in professional societies.—**John T. McKenna, Jr.**, Secretary, 1 Emerson Place, Boston, MA 02114

52 30th Reunion

Save these 1982 dates: June 10, *Tech Night at the Pops*, and June 11, *Technology Day*, plus before and after for our own gala reunion activities.—**Arthur S. Turner**, Secretary, 175 Lowell St., Carlisle, MA 01741; **Richard F. Lacey**, Assistant Secretary, 2340 Cowper St., Palo Alto, CA 94301

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We are pleased to report that **Kevin Woelflein** was elected president and chief operating officer of the American Security Bank of Washington, D.C. The American Security Bank is the second largest bank in D.C., with assets of nearly three kilo megabucks (somehow that sounds much more exciting than 3 billion dollars). It's nice to know that Kevin's many hours in the "Unit Operations Laboratory" in the basement of Building 10 have finally paid off.

Gordon Aitken is another chemical engineer who is salting it away! He is now general manager of processing for the Avery Island and Watkins Glen operations of International Salt Co. Gordon and his wife Audrey Ann live in Clarks Green, Pa., and have two daughters, Audrey Hope and Patience Ann. . . . **Jerry Cohen**, a fellow member of the Brooklyn Tech class of '50, was recently selected to receive the Henry Marion Howe Medal from the American Society for Metals for the best paper published in the journal *Metallurgical Transactions*. Jerry, who heeded Horace Greeley, is Frank C. Englehart Professor of Materials Science and Engineering at Northwestern University's Technological Institute, and has authored over 180 articles. He, his wife Lois and two children live in Glencoe, Ill.

Another academician classmate is **Ed Eigel** who was named provost and vice president for academic affairs at the University of Bridgeport. Prior to going to UB, Ed was academic vice president and professor of mathematics at St. Louis University. He and his wife also have two children and live in Fairfield, Conn. . . . **Dave Weisen** reports that his wife had a serious skiing accident after their return from Australia. Her knee was reconstructed and fortunately she is completely recovered. Dave has been active in the Educational Council.—**William Combs**, 120 West Newton St., Boston, MA 02118; **John Kiley**, 7 Kensington Rd., Woburn, MA 01801; **Louis Mahoney**, 52 Symor Dr., Convent Station, NJ 07961; **Dominick A. Sama**, 28 Chestnut Hill Rd., Groton, MA 01450

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From the depths of winter we bring you a few—unfortunately too few—notes of current activities. First, we learned that **H. Robert Farrah** has been named assistant professor of electrical engineering by the Lawrence Institute of Technology, Southfield, Mich. Bob holds a masters in electrical engineering and an MBA degree from Wayne State University. He was formerly a program manager with the Bendix Engineering Development Center.

Two quick notes accompanied recent alumni contributions. **Sidney E. Reichman** reports that the film "Danzig 1929," which he recently produced for the Jewish Museum in New York City, was awarded the Blue Ribbon at the 1981 American Film Festival held in the Big Apple. Sounds interesting Sid, let us know where the film is currently being shown. . . . **Dell Lanier Venarde** has favored us with another update. Dell is now teaching mathematics at Widener University, Chester, Pa. She is teaching half time, yet finds the job is a full-time chore thus far.

We have a release from Booz, Allen & Hamilton announcing that **John F. Wing** has been appointed managing officer of its transportation consulting division. John, who received his bachelors degree in naval architecture and marine engineering, also holds an MBA from Harvard. Prior to joining Booz, Allen in 1964, he was with the maritime division of Alcoa and the shipbuilding division of Bethlehem Steel. At Booz, Allen he has held the positions of research director, vice president and senior vice president in the firm's applied research

division; since 1976 he has been associated with its transportation group in Bethesda, Md. It sounds like the Class is continuing its takeover of the managment consulting business.

News has been very sparse over the past few months, hence our intermittent columns. Hopefully, a rash of year-end contributions will provide us with further information for spring reading. Please drop us a line so that we can keep up the flow of news.—Class Co-Secretaries: **Mark S. Gross**, Winding Road Farm, Ardsley, NY 10502 and **Allan C. Schell**, 19 Wedgemere Ave., Winchester, MA 01890

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One of the disadvantages of being class secretary is that you have to apologize for the publication deadlines you miss, which is what happened to RK last month. Mea Culpa.

One of the advantages of the job is that it gives you an excuse to call good friends from former days with whom you had lost contact. **Vic Vaughen**'s cryptic note to the alumni association gave me an excuse to call him, and we had a pleasant chat. Vic joined the staff of the Oak Ridge National Laboratory (ORNL) upon receiving his Sc.D. in chemical engineering from M.I.T. He is presently section head in charge of the engineering coordination and analysis section of the Chemical Technology Division of ORNL. The Vaughen household consists of Vic, his wife, Sally Kimberly, and his youngest son, Erik (17), a junior in high school. Leonard (21) is studying architecture at the University of Tennessee, and Bruce (19) is emulating his father by studying chemical engineering at the University of Michigan.

Joseph Gaziano, Course VI, was nominated by Governor Hugh Gallen to the University of New Hampshire board of trustees for a term running through June 1985. He is also a guest lecturer at UNH and serves on the boards of trustees for St. Anselm College, Manchester, N.H., and Berwick Academy, South Berwick, Me. He is also a member of the M.I.T. Corporation Visiting Committee for electrical engineering and computer science. In addition to these "pro bono" activities, he is president and chairman of the board of Tyco Laboratories, Inc. of Exeter, N.H. Joe and his wife, Anne Marie, live in Epping, N.H. Their three children, Christofer J., Cara Mia, and Mary Elizabeth, are students at the Belmont Hill School, Philips Exeter Academy, and Berwick Academy, respectively.

Slater Electric, Inc. of Glen Cove, N.Y., recently announced the election of Herbert A. Slater, '54, to the new post of vice-chairman, and **Thomas Slater**, Courses II and VI, as president. Congratulations to the Slaters. . . . **Rosemarie Wahl Synek**, Course VII, has been promoted to professor of biology at St. Mary's University of San Antonio, Tex. She continues her position of chairman of the Department of Biology and director of the Premedical and other health-professional programs. . . . **"Lem" Kusik**, Course X, has been with Arthur D. Little, Inc. since 1964. He presently heads a task force defining markets and opportunities in Industrial Energy Conservation.He has also recently moved from the flats to the hills of Winchester.

Dick Mateles, Course XX, was elected vice-president of research, at Stauffer Chemical Co. of Westport, Conn. last September. Dick joined the Stauffer as assistant director of research in July 1980, and had served as director of research from October 1980 to September 1981. Prior to joining Stauffer, Dick had been a professor of applied microbiology at the Hebrew University, Hadassah Medical School in Jerusalem. Prior to his moving to Israel, Dick had been a member of the faculty of the Department of Food Technology at M.I.T., which he joined upon receiving his doctorate in food technology from M.I.T. When it comes to making changes in one's lifestyle, Dick obviously does not believe in taking halfway measures. From my discussions with him at the 25th Reunion, and from his rapid advancement in the Stauffer hierarchy, he is having the time of his life, and his efforts are apparently appreciated.—Co-Secretaries: **Robert Kaiser**, 12 Glengarry, Winchester, MA 01890, (617)729-5345; **Caroline Disario Chihoski**, 2116 W. Davies Ave., Littleton, CO 80120, (303)794-5818

57 25th Reunion

We have a mystery note to start things off!! "Retired at age 49. Into solar hot water heating, wind energy conversion and photovoltare cell applications for my house." A member of the EE class, we hope to have the writer's name for the next issue! . . . **George R. Seiler** writes that he founded Profit Planning Assoc. management consultants, in 1978 to offer assistance in business planning, analysis, and control. He has authored the American Management Association 1981 Management Briefing, "Control: The Key to Successful Business Planning." George lives in Glen Ridge, N.J., with wife Jean and their 4 1/2 year old son, Mark.

Pete Sinz writes from Puerto Rico, excerpts from which follow. We wish we could quote it all, but space will not permit: "**Ben (Chertok)** and I kept in contact over the years, and had been at the 15th reunion, with real wishes to be together for the 25th, and more. There will be a good piece of my memories that will not be relived next June. A lot of goodness and good cheer left with Ben's passing away...My small business has grown into a large fire protection contracting firm with over 40 employees, engineers and draftsmen/designers. We do all the design fabrication and installation in-house...My wife Isabel still remembers many of the Tech friends and is looking forward to seeing them (**Hollis French**, **Deane Kihara**, **Bob Koch**, **Bruce Grover**, **Phil Cammack**, Al Bufferd, '59, and Frank Tahmoush, '58). She especially remembers **Alar Toomre** from the 15th reunion. Hope to see all of the 'old (more or less) timers.'" A great letter with real enthusiasm for the upcoming reunion.—**Fred Morefield**, Secretary, Shared Medical Systems, 650 Park Ave., King of Prussia, PA 19406

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Arriving in the Christmas mailbag was a copy of the August 1981 issue of *Systems-Objectives-Solutions*, an international journal focusing on information processing. Leading off the issue was an article by **Robert Baber** titled "Software Reflected; The Land of Moc." In the article, Bob relates the amusing tale of the rise of a new technology in an ancient land, and compares it with the status of the software industry today. The article presents some of the concepts from Bob's forthcoming book on the software industry. He and his family continue to live in Bad Homburg, Germany, near Frankfurt, where he is an independent consultant.

At the International Institute of Applied Systems Analysis symposium in Vienna, Dr. **Elizabeth Drake** spoke on the topic of improving safety standards for LNG and LPG storage facilities throughout the world. . . . At M.I.T., Professor **Kenneth Smith** has been appointed vice president for research, a position previously held by the late Thomas F. Jones. Ken will retain his present position as associate provost in addition to his new duties which include responsibility for the Francis Bitter National Magnet Laboratory, the Center for Materials Science and Engineering, the Energy Laboratory, the Center for Space Research, and several other functions.

Ed Vinarub writes that he is "now working for a new fiber optics company, Eotec, located in West Haven, Conn. As manager of the electronics/electro-optic group, my task is to exploit new commercial possibilities for the use of fiber optics." . . . Another letter this month from **John Boynton** tells us "that the Class of '58 should start planning some really interesting activities for the 25th reunion. I plan to fly my own designed and built airplane up there with a lady of my choice (the right seat is designed for a maximum of 135 pounds). The plane's non-stop range will be over 6,000 miles, so unless there is a red-carpet reunion, I will turn around and return to Houston."

Reunion planning is underway, you'll be glad to know. Based on the tremendous enthusiasm for returning to Martha's Vineyard, your secretary has made confirmed reservations for the reunion at the Harborview in Edgartown. You'll be hearing more about the reunion from me in this column, as well as from our reunion committee.—**Michael E. Brose**, Secretary, 59 Rutland Sq., Boston, MA 02118

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Last May, the *Boston Globe* carried an interesting article about **Sheila Evans Widnall** who is a professor of aeronautical engineering at M.I.T. She just finished up as chairman of the faculty and has now returned, full tilt, to the regular academic grind. Sheila is considered to be a world class expert on aircraft turbulence. On the side she raises two children, William (17) and Anne Marie (13). In the article she is quoted thus: "Parents should encourage their daughters who do well in science and math to continue with those subjects so that their career options will be wider. And that decision has to be made early in high school."—**Noel S. Bartlett**, Secretary, 15320 Edolyn Ave., Cleveland, OH 44111

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Now that I have gotten my act together I will report to you on the activities of last June at our 20th Reunion. It was, in a word, wonderful and I had a great time, somewhat to my surprise. The cooperation of the alumni office was terrific and everything went like clockwork. It helps to have **Bill Hecht** running the office! **Tom Hastings**, as class president, was responsible for organizing things and keeping the local committee busy. **Dave Latham**, who kept the books, reports that from the financial point of view every thing went well. A small surplus will be invested wisely and will provide a nest egg for our 25th reunion.

The reunion started off with a very well catered affair at the Pierce Boathouse (where the crew normally hangs out) on Friday night. There was a beautiful sunset on the balcony and pleasant company inside. Half way through the evening we were visited by the Logarythms which is now a coed group. We were serenaded for about an hour by this attractive group that recalled many of the songs of our youth and brought us up to date on the latest Institute songs. People lingered at the party until well past midnight. **Henry Gabelnick** took us back to his room in McCormick Hall to show us the view. There are few dorms in the world with such a magnificent view given to Tech Tools. A glittering Boston vies with the 8.01 book for their attention. The rooms are monastic in style so that ones roommates won't interfere with the studies at hand. Henry works for the National Institute of Health in Bethesda on, of all things, contraceptive technology! A fine fate for a chemical engineer. He travels around a lot to underdeveloped countries to advise them about how to keep their populations in check.

Saturday was open for people to visit the sights in Boston and at 3:00 everyone met at Museum Wharf to board the steamship *Calliope* for a ride back to the Institute. It's a new boat built around the turn of the century with the engine full of smooth running pistons and dripping grease. We arrived at Pierce Boathouse just as a squall line hit and ran for cover just as another class was getting on the boat to go back to Boston. They must have had a miserable ride!

That evening we all convened at the New England Aquarium, which we had all to ourselves, for quite a show: the sharks were fed by a scuba diver while we all cringed, and a band played during cocktails. For us old Bostonians it was quite a change to wander around the huge shark tank, drinks in hand, instead of sidestepping the hoard of screaming children one usually finds there. Dinner was served next to the tank and an occasional hungry-looking shark would float over to see what we were doing. Talking mostly. We sat next to **Harvey Eysman** and his wife Donna. Harvey is a lawyer who writes books on the side (or perhaps it's the other way around) and just finished a thriller called *Courier's Fist*, which is published by Beaufort Books and distributed by Scribners. . . . **Joe Harrington** and his wife DeeDee led the dancing that followed the dinner. Joe said that he has left the nuclear end of the electric power industry and is now in charge of the New England electrical systems coal, oil and natural gas-fired plants. Joe lives in Westborough, Mass., with DeeDee and their two boys, Joe (14) and Robert (12).

Next morning we were scheduled to have breakfast outside in the president's courtyard but the rain had continued through the night so we set up shop in the Bush Room in Building 10. There we drank Bloody Marys and voted in a new class president, **Ben Zarren**, who you should be hearing from soon. There doesn't seem to be a class treasurer but Dave Latham has all of our money so I guess he becomes *de facto* treasurer. There is no class agent so we would be glad to take some volunteers. The agent is responsible for getting the class to cough up donations to the Institute. We also need an executive committee which will eventually take charge of the next reunion. And finally, I was reelected as secretary.

Here are a few gleanings from some of the people who came to the reunion. **Ben Turetzky** and his family returned to the northeast about a year and a half ago after spending two and a half years in Beaumont, Tex. Now they all live in Mountain Lakes, N.J., and Ben is the Atlantic District sales manager for Synpol, Inc., which is owned by Uniroyal. They make synthetic rubber at Synpol. . . . **Dick Naylor** is on sabbatical from Northeastern University where he is the chairman of the Earth Sciences Department. . . . **Gil Stegen** is still an assistant vice president at Science Applications, Inc., in Bellevue, Wash. Gill is heading a group in oceanography, computer science and applied physics.

Well, that concludes my short report on the reunion. Next month I will report on the results of our questionnaire. They were quite interesting and it is fun to compare the answers last year with those ten and 14 years before.—**Andrew Braun**, Secretary, 464 Heath St., Chestnut Hill, MA 02167

62 20th Reunion

Another newsclipping has arrived describing **Martin Klein** and his company, which manufactures underwater sonar profiling systems. He has personally been involved in the search for the Loch Ness monster and his equipment has also been used to discover a sailing ship which sunk in the arctic in the 1850's and one which sank in Lake Ontario during the War of 1812. . . . **Edward F. Maguire** has been appointed business manager for the Northboro and Southboro, Mass. schools. . . . **Scott L. Danielson** is senior professional associate (assistant vice president) of Parson Brinckerhoff-Quade and Douglas, architect engineers in San Francisco. He is in charge of architecture in the western region.

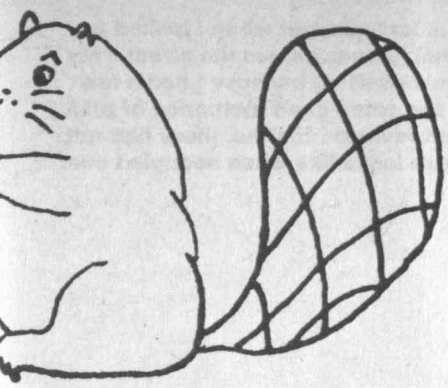
Richard Bronson is associate director of the division of human reproduction and director of the Laboratory of Human Reproduction at North Shore University Hospital, Cornell University Medical College in Manhasset, N.Y. . . . **David H. Vilkomerson** is managing director of the special research group of Technicare, a Johnson and Johnson company dealing with research and development for advance imaging devices such as those used for ultrasound detection of early breast desease. . . . Would anyone who realy believes that it's been twenty years since we graduated please write me.—**John E. Prussing**, Secretary, 2106 Grange Dr., Urbana, IL 61801

63

Greetings and salutations—I hope the new year is treating you well. Right to business, this month we have a good supply of notes and envelope flaps. **Dan Eckard** writes to tell us that he is a co-founder and principal officer of the OPUS Corp., which produces turnkey business and technical computer systems. Dan, his wife Judy, and their three children live in Potomac, Md. . . . **William Barnett** has left the staff of the board of governors of the Federal Reserve System to accept the position of professor of economics at the University of Texas at Austin. Good luck in the new post. . . . **John C. Cheney, Jr.** informs us that he is a principal of the Cheney Architects, where he has been since 1975, and is the proud father of a daughter, born in May 1981. John also has three boys, and reports that he is enjoying newborn fatherhood again. . . . **Ed Eudewicz** had his book *Handbook of Random Number Generation and Testing with TESTRAND Computer Code* published by American Sciences Press this year. He was also elected a fellow of the American Statistical Assoc. Ed will be presenting a short course on Design and Analysis of Industrial Experiments in March and would welcome inquiries from classmates.

A long and newsy note from **Larry Beckreck** fills us in on his doings in recent years. The Beckrecks are living in England, and Larry is sales manager for Genesys Ltd.He sells micro and minicomputers, and software to civil engineering consultants, structural engineers, contractors, architects, and others in the construction industry. He travels abroard frequently to promote these products under Genesys' new parent company, Quest, to talk about computer aided design, drafting and manufacturing. He hopes to get to the States (the colonies?) soon to visit clients interested in CAD for architects. Larry and Julia celebrated 16 years of marriage since their December wedding in the M.I.T. Chapel. Julia is teaching seven and eight year olds and still enjoys it very much. Son Seth, now 13, likes trombone playing, air scouts, microcomputers, and plans to go to M.I.T. before becoming a lawyer. The Beckreck's other son Joshua, loves football (soccer), is an avid coin collector, and is soon to celebrate his twelfth birthday. Larry says he has many friends in England, but he sometimes misses the good old USA—particularly his old friends. During their six years in the english Midlands the improvement and redecoration of their thatched cottage has proceeded well under Julia's hand. Among the classmates who have seen the cottage are Margie and **Larry Krakauer**, **Marty Schrage**, and Barbara and me. The Beckrecks have been in touch with Lyla and Dave Johnson, who live in London, and have seen Carolyne and **Ira Blumenthal**, and Carol and **Pete Van Aken** on visits to Boston.

I recently spoke on the phone with **Mike Schaffer** who is living in the San Diego area, and working for General Atomic on a new magnetic plasma confinement project of fusion energy production.



As a special feature of the upcoming June class reunions, don't miss "Tech Nite at the Pops," Thursday evening, June 10, 1982.

The device, dubbed the OHTE, began operation in March 1981. Mike has worked in this group for about two years and is also active in M.I.T. Alumni fundraising in the Southern California area.

Well, that does it for this month. Keep those cards and letters comin' in. (Ha, ha.)—**Mike Bertin**, Secretary, 18022 Gillman St., Irvine, CA 92715

67 15th Reunion

We are expecting an excellent turnout for our spectacular 15th Reunion in Cambridge on June 10 through 13. You will enjoy it.

After two and a half years in Hawaii, **David Ofsevit** is back in the Boston area and still working for MITRE. He and Nancy Mazonson were married in March of 1980 and now reside in Watertown. He recently visited Anne and **Paul Tarantino** in San Jose. . . . **Bill Ford** is an associate professor of mathematics and computer science at the University of the Pacific in Stockton, Calif., and is responsible for coordination of academic computing activities. He and his wife Shirley, who is a high school mathematics teacher and a relief pharmacist, have two sons, Bret Andrew (10/24/73) and Bryce Meritt (7/7/77). . . . **Jeff Schoenwald** is still with Rockwell International's Microelectronics Research and Development Science Center. After eight years in surface acoustic wave research, he is working on optoelectronics (lasers/detectors) and fiber optics. Jeff and Sheri have one son, Joshua Anson. They are interested in hearing from anyone in the vicinity of Thousand Oaks, Calif.

Kevin Kinsella has joined Nucorp Energy, Inc., in San Diego as director of venture development. He is in charge of business and opportunities research for Nucorp and its oil field manufacturing and supply subsidiaries. Kevin was previously with Solar Turbines International, a division of International Harvester, where he was responsible for all of its worldwide marketing activities in countertrade, barter and offset. . . . **Harry Pellow** writes that he is "alive and well" in Cupertino, Calif. Harry who is married to a "blue eyed, blonde haired California girl," writes books, and drives a Porsche. He included some information about fellow grad Barry Starr, who is living with his wife Linda and son Adam in Castro Valley, Calif.—**Jim Swanson**, Secretary, 878 Hoffman Terr., Los Altos, CA 94022

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Welcome once again from Watergate City on the shores of the sunny Potomac River. Winter is settling in as I write this and we've almost finished raking leaves for the year. . . . **Robert Mitchell** was married to Linda Laffen of Boulder, Colo., on October 16, 1980. . . . **David Seldin** reports the birth of Margot (his fourth child) last fall. He says that Jeffrey (eight), Shana (six), and Miriam (five) are all pleased with their new sister and their newly remodeled house. Dave continues to enjoy "the big apple" where he is still pursuing research and clinical work in nuclear medicine at Columbia-Presbyterian. . . . **Richard Ying** continues as executive vice-president at Atex Co., of Bedford, a company he helped found and which was recently acquired by Kodak for almost $82 million in stock according to the *Boston Globe*. The company supplies computer based publishing systems to newspapers and magazines and will continue to operate independently.

From Poughkeepsie, **Ron Rosen** writes that he is now serving part-time as academic services coordinator in the computer center at Marist College and is "busier than ever" with his own custom software development business. Ron and Marilyn are also serving as volunteer overseers for the Appalachian Trail segment in Duchess County where they are coordinating the efforts of over a hundred volunteers in moving the trail from boring road walking into the woods and hills. . . . After five "long" years, **Paul Maguire** received his masters in computer science from Boston University. He is working at Raytheon in systems software to help implement a division-wide software configuration control system on their new VAX. . . . Nearby, we hear that **Steve Gamer** is now a senior engineer and project leader at the Avco Everett Research Lab.

After spending last year on a postdoc at Harvard and M.I.T., **Dan Asimov** has joined a Stanford University department of statistics project involving the application of computer graphics to multidimensional data. . . . When last heard from in the spring, **Henry Jaffin** was completing an orthopedic surgery residency in Los Angeles and "looking for his next step." . . . **Don Baker** is working the U.S. Naval Oceanographic Office at the NASA Test Site in southern Mississippi. He is involved in building a CMOS microprocessor system, with contracted support from Mississippi State University to apply to buoys and underwater instrumentation. The first application will be to monitor geomagnetic disturbances in magnetic survey areas with an air-dropped buoy. . . . Last June, **Wilson Lamb** began a new job with Exxon designing acquisition and sensor systems for large scale experiments.

In case you didn't notice it in the news section of the *Review*, **Lissy Quinlan** was promoted to associate professor of mechanical engineering at the 'Tute last April and is doing research in the field of ecosystem dynamics. . . . From the West we hear that **Richard Zvouar-Griggs** is working on a doctorate in composition at the University of California at San Diego producing a concert series at the La Jolla Museum of Contemporary Art, and working as a research assistant at the Center for Musical Experiment and Computer Audio Research Lab. He received a mention in last year's competition at the Bourges, France festival of Electroacoustic Music for his piece "3 for 5", written for solo percussionist and four-channel tape. . . . **Bob Metcalfe** points out that his name recently appeared in the other part of the *Review* in an ad from "his beloved *former* employer, Xerox" crediting him with the invention of the Ethernet, a local computer networking system which is very popular. He adds, "when I see my name in *Tech Review* it's like a triumphant return home."

Finally, in September I (Mike) was promoted to acting chief, research and analysis division, in the FCC's Office of Science and Technology and am responsible for both a varied research program and giving technical guidance to the commission. Gail continues in her job in the Congressional Research Service. Last spring, we made bureaucratic history by being the first couple to attend the Federal Executive Institute at the same time. However, as the bureaucracy was recovering from the shock, another couple repeated the feat the next month. After attending M.I.T. together for seven years, we saw no reason why we had to be separated for this program. That's all we have for now, please drop us a line—**Gail** and **Mike Marcus**, 8026 Cypress Grove Ln., Cabin John, MD 20818

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It is my sad duty to announce that **David A. Roe** died on February 20, 1981. His sister writes, "We are all honored that David was able to attend your school and do so well. I believe his fondest memories were those school days. We were happy to be able to honor his pledge to you. Although we regret and grieve his passing, we know he is whole again and no longer crippled by polio as he was here on earth. May God bless you, his friends, teachers, and associates."

Al Solish is in his second year of opthalmology residency at the UCLA Jules Stein Eye Institute. His wife (Margaret Frerking, '72) is at Jet Propulsion Labs. He hopes his friends will call him via the Culver City telephone book. . . . **Timothy M. Bradley** writes, "I've been living on 'Fantasy Island' (Kauai) since graduation and am enjoying the quiet life style. I was the only architect on the island for close to five years. I now have a partner, and design mostly homes, usually four to five nice ones a year. I've done one small condo job and am finishing my first small shopping center. It is sad one must work in paradise! In my free time I enjoy fishing or the beach with my wife Stormy and my two kids." . . . **Jeffrey Folinus** is getting set to break three hours in this year's New York Marathon. Jeff is still editing *INFO*, and working for TVS&A in Atlanta.

Roy L. Whiddon has become a Canadian—he's living in Toronto and working for Infomart on the development of the Telidon Videotex system. Infomart is the number one marketing agent for Telidon systems worldwide. . . . **Gerald Kardas** writes, "After several years on the West Coast, we returned to the Hartford area in early 1979. I rejoined the engineering department at Pratt & Whitney aircraft, and since September 1981 I have been involved in corporate technology activities at Combustion Engineering, Inc. Jan (Wellesley, '71) is completing her Ph.D. dissertation in ethnomusicology from the University of California at Berkeley. Our five year old daughter Ellen is absolutely delightful. P.S. Whatever happened to Harlan Chizen?" . . . **Bill Preece** has recently married and is living in Stamford, Conn., where he works for Xerox.—**Hal Moorman**, P.O. Box 1808, Brenham, TX 77833

73

It looks like a slight improvement in the volume of news this month. **Cha-Rie Tang** has joined the ar-

I was walking down Commonwealth Avenue last summer when I looked up and recognized the *Phi Kappa Theta* fraternity house across the street. "My God they've had a fire!" I said. This was real upsetting because I had a few friends at the "Ate-a-potato Spud House" and some good memories of rush parties my freshman year. Closer inspection revealed that no, there had not been a fire, that's just what a fraternity house looks like when occupied over the summer.

C. Tang, '73

chitects and engineers division of Theodore Barry & Assoc. as a project engineer. Miss Tang will have responsibilities with the Los Angeles firm in architectural design and the creation of renderings. . . . **Jeffrey Harris** finished his master's in electrical engineering at the 'Tute in 1975 (haven't heard much from him) and then spent a year and a half at Oak Ridge, Tenn. in tokamak research. Jeff did his doctoral dissertation at the University of Wisconsin in stellarators which, as you all know, are toroidal plasma devices similar to tokamaks. Jeff is now back at Oak Ridge after a summer in Moscow where his "excellent M.I.T. Russian training paid off."

Old G-and-S-mate **Susan Stopek** is a staff psychiatrist at New York Hospitals' Westchester division where recently she birthed a baby daughter of unquoted name and birthed, with comparable labor no doubt, a publication on "Language Discourse Analysis" which was accepted in "Brain & Language."

Roger Bowers will finish his cardiology and nuclear medicine residencies in June and is now considering practices in upstate New York. His wife Denise is expecting their second child in November (1981) and Roger invites Ann Arbor-bound friends to look him up at the nuclear medicine division of University Hospital there. . . . **Carl Rosenberg** calligraphed a note on the completion of his residency in neuro and resides in the land of the Lotus Eaters doing research. I confess to knowing not where that is, having no postmark on his letter, but if it's near the land of the Grit Eaters, he's close enough to come visit us.

Russell Dominique is married with a 14 month-old daughter, Amelia Claire. He is working near Washington for the Naval Surface Weapons Center and invites any old Burton or McGregorites to look him up in Takoma Park, Md. . . . **Edward L. Astrachan** is engaged to marry Lillian Spatz this spring. He passed the final exam to be a fellow of the Society of Actuaries. Currently, Edward is employed by the Masscuhsetts SBLI in Boston. . . . **Mark Horenstein** is now assistant professor of electrical engineering at Boston University, working in the high voltage research area in problems of industrial electrostatics.

A frequent correspondent, **Tom Lydon**, writes that he's expecting his second child any day. He recently bought a house in Clinton, Conn., near where he is working in solar R&D for Sunsearch, Inc., and teaching at the Yale School of Architecture. Not playing much hockey, he says, but the winter's near. . . . **Tony Scandora** had incredible edible eggs for breakfast today, which tells you how much news **he** has for me. Yours over-30ily has a new position, though. Not, as you think, cramped up near the door, but as data processing manager for the CPA firm of Surles and Assoc. of Warrenton, a three mile drive from home instead of the 45 minute commutes I'm used to. This will give me oodles of time for the pursuit of soccer, both of my own teams (2-2-1 as of 11/5) and Eric's, coached by Daddy (4-3 and on their way). I really do look forward to this new position and welcome any advice on how to manage three females. I can't even get my wife to cook crepe suzettes. Write.—**Robert M. O. Sutton, Sr.**, Secretary, 819 Buckingham Ct., Warrenton, VA 22186

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I was walking down Commonwealth Avenue last summer when I looked up and recognized the *Phi Kappa Theta* fraternity house across the street. "My God they've had a fire!" I said. This was real upsetting because I had a few friends at the "Ate-a-potato Spud House" and some good memories of rush parties my freshman year. Closer inspection revealed that no, there had not been a fire, that's just what a fraternity house looks like when occupied over the summer. It got me thinking that there should be more living-group related news in this column. I have tried to print every piece of news I can find about people I knew at Fiji-house, but what about SAE? What ever happened to Margo-what's-her-name? What news from former Burton Third-Floor Bombers? Was anyone at Bexley *not* involved in the traffic of controlled substances? In other words, news about people you know is just as good to hear as news about yourself when you write.

We have several announcements in the way of class business. The notice published in the October Class Notes about *Class Rings* was slightly in error. The Dieges & Clust Co. is not selling original Class of '74 rings as reported earlier, but the one they are selling looks a heck of a lot nicer than the one they're selling through the Coop (in my opinion). Prices are around $225 for 10-karat yellow gold, $300 for 14-karats, and you should contact Cheri Lawson at (401) 331-1240 for an order form and sample ring. . . . Lots and lots and lots of people contributed to the Alumni Fund this month as well as this year. Total donations from our class for 1981 amounted to $13,790. Thank you to all who contributed. . . . Class president **Sandy Yulke** who would like to point out that contributions to the Alumni Fund from our class designated as "unspecified" are not really unspecified—they automatically go to the Intramural Fund. Our class is the only one with this restriction so we may want to consider voting it down at the next reunion. Make a note of it.

Sheva Stern Mann is completing her residency in internal medicine at the New York City Beekman Downtown Hospital. Dedicated as she is, she still took a month off to have a son, Moshe Peretz. . . . A nice hand-written letter from Sharon Horowitz tells of husband **Alan Horowitz** and first son, Daniel Israel, born last May 20. Alan is an assistant to the Solicitor General, at the Department of Justice and Sharon is on leave from the Library of Congress—she's going to be the mother for a while. Alan asks of the whereabouts of **Rhett Butler**. . . . **Gary Klein** makes hand-made bicycle frames, and quite well apparently, judging by the fact that they can be had for a mere $2,300. "I'm selling to bicycle enthusiasts," says Gary in what may be the understatement of the year. They sold 100 frames last year with a two-month waiting list. . . . **Peter Dietz** has been named manager of the electrical technology branch at the General Electric Research & Development Center in Schenectady.

Jim Taul is studying decision analysis and systems theory at Stanford. He mentions that **Greg Burnett** is living in Los Angeles and working as an architect. . . . **Robert Shapiro** got himself appointed assistant professor in the political science department at Columbia University starting in 1982. He will also be receiving his Ph.D. from the University of Chicago in 1982. Busy, busy, busy. . . . **Bob Gahl** finished his residency in the summer of '81 and is now in family practice in Two Rivers, Wis. "Jan just had twin sons whom I hope will eventually wrestle at 142 and 150 pounds. I am very pleased. Our two year old daughter also enjoys her brothers." . . . **Bruce Schobel** writes a nice long note. (In fact, everybody does—we have a class of writers.) Bruce is fascinated with his new daughter Catherine. Jeanne and he are having fun. He's an actuary in the Office of the Deputy Commissioner of the Social Security Administration, and apologizes for the size of his annual contribution, not realizing that the fact that it is annual alone makes it significant.

Mark Mazak writes, and a newsclip has arrived at the same time with his beautiful visage, saying he's left the Massachusetts Department of Public Health to become director of planning at the Melrose-Wakefield Hospital in Melrose, Mass. He says he loves camping and bicycling (pssst...wanna buy a frame real cheap?) and does a lot of both. . . . **Paul Pangaro** is punching away at his Ph.D. in cybernetics in England, consulting on both sides of the Atlantic in decision systems (and don't forget the national television appearances). . . . **David Leinweber** is a member of the Academy of Motion Picture Arts and Sciences Technical Award Committee, which means he votes to determine who gets an Oscar. He's consulting on space systems at the Rand Corp. and information product strategy at Litton Industries.

Jeff Weinreb is leaving the Long Island Jewish-Hillside Medical Center in July (where he is chief resident) to become a fellow in computerized tomography and ultrasonography at the hospital of the University of Pennsylvania in Philadelphia. For a doctor, he has beautiful handwriting considering all the big words. . . . **Louis Gutentag** has been promoted to director of corporate systems at J. Aron & Co., a commodities trading firm in the Wall Street vicinity. . . . I saved the best note for last. **Fred Shapiro** writes, and I quote, "I have had three articles published in linguistics journals and have six more forthcoming. Of somewhat greater importance is the fact that I was married on June 19, 1981 to Jane Elizabeth Garry. We live in Washington, D.C. now, but the proximity to Reagan, Weinberger, Watt, Haig and other criminals is

more than we can stand, so we will probably return to Boston in the near future." I would only add that there are lots of other fine reasons for living in the Boston area as well. Did anybody notice we have a lot of Big Guns in our class?—Co-secretaries: **Lionel Goulet**, 34 Tremlett Square, Dorchester, MA 02124; **Jim Gokhale**, 12 Pond Lane, No. 54, Arlington, MA 02174

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The mails, like some of the markets, are a bit thin these days. **Bob** and **Judy** (nee **Leider**) **Lambe**: were expecting their first baby in January 1982. . .

Susan (nee **Fife**) and **Fred Dorchak** have sent word of the birth of their daughter, Lauren Nicole, on August 8, 1981. Congrats. . . . And we have a letter from **Gabos Szakacs**: "I am now working as project engineer at the Jarrell-Ash Division of Fisher Scientific in Waltham, Mass. On September 19, 1981, I married Kathleen Dziewisz (Simmons, '81) in Glastonbury, Conn. We honeymooned in Bermuda and the Berkshires. We're now living in Brookline. . . . **Dave Agans** and **Mike Mavel** attended the wedding."

I am afraid that's it for news. As for your secretary, life is continuing in the commodities pressure cooker. I've been trading British Pounds, Swiss Francs, copper, and cocoa. They, plus T-bills and T-Bonds, have had some uproarious movements, including a few which have caused your secretary to break into a profuse, clammy sweat (temporarily). I have not decided on my next course of action, however I am considering moving to France or Italy for a while. Regardless of where I am, we shall continue to have Class Notes.—**Arthur J. Carp**, Secretary, 15 Jones St., Apt. 3D, New York, NY 10014

77 5th Reunion

For my first column as secretary pro-tem I am fortunate to have lots of mail from our class. Starting from the West Coast, **Robert Byard** married Karen Despain in 1978. He received his M.S. degree in computer science at the University of Utah in 1979, and now has a one-and-a-half-year-old daughter, Barbara Jean. Robert is working at Hewlett Packard Data Systems Division in the Bay area, and is attempting to make his fortune in high-tech stocks. Good luck, Robert! . . . **JoAnn Ivester** has graduated from Stanford Business School and is now working for the San Francisco Municipal Railway. Husband Jonathan, '78, spent the summer working in a geothermal lab in the Geysers area of California while living in Napa Valley. . . . **Dan Leighton** notes that he has moved to San Francisco for a few months "because the wind is better in the summertime." Dan, have you taken up kites or hang-gliding?

Moving on to the East Coast, Jan Krakauer is studying for his MBA at the University of Virginia. . . **Mark C. Van Stolk** has just started a new job with Schnittker Assoc. in Washington, D.C., as a commodity analyst. . . . **Sue Stewart** is spending her time doing "lots of gardening," and a project in yeast genetics at Brandeis, where she is in her third year of graduate school.

Michael Cady has recently been promoted to senior project manager for Manganaro Corp., in Malden, Mass. Congratulations, Michael! Michael also reports that Barbara Hill, '80, has joined Manganaro Corp. as an assistant project manager. . . . **Kevin Miller** is currently serving his internship at Hartford Hospital. Kevin intends to specialize in psychiatry, and hopes to do some research during his residency.

Ken Arbit has spent three busy years as a systems analyst/programmer/salesman for a division of CDC while being a full-time MBA student at Rutgers. After graduating in May, Ken bicycled from New Jersey to Boston for a visit. In June, Ken moved to Israel and is "having a wonderful time getting acclimated." Ken volunteered a tour of Jerusalem; drop him a line at: Ein Rogel, 16/12, Jerusalem, Israel.

As for myself, I am working for Digital Equipment Corp. here in Colorado Springs. My husband Mark, '76, and I have bought our first home, which has a marvelous view of Pikes Peak. Mark and I have helped organize an Educational Council for Colorado Springs, and are enjoying ourselves very much here. I'm still active in roller skating, as well as judging competitions. To all of you whose names have changed since you were at M.I.T. please note your old name on information for class notes, as well as your present name. This will help those who have lost touch to recognize you in the notes.—**Barbara Crane** (nee **Wilson**), Secretary, 6431 Galway Dr., Colorado Springs, CO 80907

78

Good evening all. I have a small (embarassingly small) pile of news for you all, so with almost no further ado we'll start with family news. **Gordon Zuerndorfer** was married this fall to Ellen Talner, a Simmons grad. Gordon is a third year medical student at Boston University (after getting his master's from the 'Tute), and Ellen teaches at the Technology Children's Center. They live in Newton. . . . **Sam Senne** and **Carol Ann Brown Senne** just had their second child this past May. Brian's daddy, Sam, is currently developing a solar powered air conditioner for which he hopes he can find a market in Florida. Brian's mommy, in her spare time, is a contractor building houses in the booming Florida sun belt market. Both go to school in the evenings for their MBA's.

My postcard collection received some big contributions this month. A card from **John Richmann** shows a jackrabbit among some sagebrush, titled "Hello from Texas." John writes, "After three-plus years I am alive and living well in Austin. For my first two years since graduation I was gainfully employed at Data General's R & D Labs. I also dabbled in local politics for a while, and served on the City Building Standards Commission. For a year I have been working on an MBA at the University of Texas in Austin." . . . From **Paul Martin** I received three cards from the Brussels National Airport and one classic from the Mark Motor Inn in Anderson, Ind. (carefully omitting the chemical plant across the street). Paul writes, "After turning in my thesis I took off for Europe with the University of Illinois Band's Clarinet Choir, the group having been invited to play at the International Clarinet Congress in Paris." After that he toured central Europe, including the Mosel and Rhine valleys and the Black Forest, with some friends. When he got stuck in the Brussels airport for an extra day because of the air traffic controller's strike he managed to find three of the most boring postcards that it has ever been my pleasure to receive. Paul finished his master's in electrical engineering at Illinois and is staying on for his Ph.D.

Janet Freeman sent me a postcard from her new home in Redondo Beach, Calif. Both Janet and her husband, Peter Cunningham '77, have started to work for Hughes Aircraft in El Segundo. Janet writes, "I'm in the space antenna systems department, working on communications satellites. Work is *much* different than the family business in Tacoma, Wash. Here, we live one block from the beach with almost no smog, and moderate temperatures." . . . **Jennifer Lyn Hall** was one of 20 advanced students in the sciences and engineering participating in the Mass Media Science Fellows Program. The program, sponsored by the American Association for the Advancement of Science, is sponsoring her in an internship as a researcher-reporter at the science department of *Newsweek*. Lyn has a year and a half to go on her Ph.D. from M.I.T. in earth and planetary science.

Ray Swartz is still working as an energy conservation analyst with the Massachusetts Energy Office. In his spare time he's learning to play the electric guitar. . . . **Richard Brudnick** graduated from the Sloan School in '79 and is now living in Boston and working for Bain and Co., a strategic consulting firm. . . . **Kelly Pan** seems to have survived her first year at Harvard Business School (well, at least she made it to her second year) and spent last summer having a "fantastic" time in San Diego, doing strategic planning and competitive analysis of a new product line for Hewlett Packard. . . . **Richard Berry** is working for Ford Motor Co., designing microprocessor-based instrumentation products for the Advanced Instrumentation and Entertainment Engineering Department. He's based in Dearborn, Mich.

Frank Chung is finishing up at Stanford Business School this year and he's planning to stay in California after he graduates. . . . **Laura Swire** reports that she has her master's in mechanical engineering from Berkeley, and is now working towards her professional engineer's license. She's working for General Electric doing work on nuclear energy. . . . **Brad Albom** is working for Chevron in California, doing R & D. In his spare time he dabbles in real estate development. . . . **Regina Murphy** is also working for Chevron, but at a refinery. She's active in cross-country skiing in the mountains—just a drive away.

Many of our classmates will graduate from medical school this coming June and are now interviewing for internships. Among these doctors-to-be is **Bill Pritchard** who is looking at hospitals in the Boston area, and **Cathy Chiles**, who hopes to work in psychiatry.

Finally, there's me. I'm still an under-employed lawyer in Boston; I have a half time menial job,

and I'm doing some free lance legal work for a litigation firm in Boston. However, I expect that by the time you read this, I will have a real job—I hope. One thing that has been keeping my spirits up is the torrent, or rather, drizzle, of mail that I've been getting from classmates. I'd hate to turn this into a yearly column, so write. Wishing you all a happy and warm winter.—**David S. Browne**, Secretary, 148A Hancock St., Cambridge, MA 02139, (617)491-5313

79

Greetings, sports fans! It never rains but it pours. After last month's mini-column, I suddenly got a deluge of dirt. Here goes.

Suzanne Burzyk has changed jobs and is now at Polaroid. She has just been elected to the executive committee of the Boston section of the American Assoc. of Mechanical Engineers and is their treasurer as well. She has also just been elected to AMITA's nominating committee, and has been asked to join the Alumni Council. However, she still finds time to play squash! . . . **Pat Peters** reports, "I am dead, and living near San Francisco." (Hmmm...) . . . **Todd Peltzer**, Lt. (jg), USN, is a deep sea diving officer aboard the *USS Edenton*, a resue and salvage vessel that was in overhaul at the Norfolk Naval Shipyard when Todd wrote. "In the past year I've participated in two aircraft salvage operations: an Air Force FB-111 off the coast of Maine, and a Marine Corps F-4 off the coast of South Carolina. This past summer I returned from a five-month deployment to the Mediterranean with *Edenton*, which included port visits to Brest and Toulon, France; Naples and la Spezia, Italy; and Rota, Malaga, and Palma de Mallorca, Spain. I had the good fortune to run into Jim May '81, an ATO fraternity brother, while on leave in Rome!" . . . **M. Bradham Brewster** got an M.B.A. from Northwestern University and is now a mechanical engineer at an Exxon refinery in Aruba! He writes, "The Caribbean is beautiful: always 85 - 95 degrees, and lots of sailing, snorkeling, tennis, and casinos. I love to have visitors!"

Andrew Weiss spent a year as a shutter design engineer with Polaroid in Cambridge. In September 1980 he started an M.B.A. program at Columbia University, and spent his M.B.A. summer on the corporate planning and development staff at Becton Dickinson. . . . **Ed Tarney** writes, "I have recently joined forces with an Ivy-Leaguer (Cornell) to form Tiny Barber Assoc., a real estate development outfit (I'm Tiny, of course!). We are currently developing resort homes in the Finger Lakes region of central New York. Our profits mostly go toward supporting local off-the-wall eateries and punk bands. Evenings I mostly sit and vegetate or drink, often both. Are you tooling, Baker Gnurds?!"

Michael Good got his master's in computer science from M.I.T. in the summer of '81, and is now a software engineer in human factors and advanced development, small systems software, for Digital Equipment Corp. in Maynard, Mass. (Michael also wins the handwriting award!) . . . **Brad Myers** is with the Three Rivers Computer Corp. in Pittsburgh (Hi, Brad!) . . . **Jose Perez** is finishing up his master's thesis in political science at the 'Tute, and also working as a programmer for Polaroid in Tech Square.

William Parkinson has formed a corporation, Nutrition-Health, Inc. "We are avidly developing and promoting health maintenance strategies aimed at the industrial work force. Our goal is to improve productivity by optimizing worker health." . . . **Anne Michon** is now at Ross Systems, a computer timesharing and financial consulting firm in Palo Alto, Calif. She is one of two people in R & D helping to enhance the company's two business products, MAPS and INTAC, and convert them to Pascal.

Many congratulations are in order for all the class newlyweds. **Jim Lester** married Margaret McCaig at the M.I.T. Chapel on August 8, 1981. Jim will graduate from Duke Law School in May. . . . **Beverly Schluckebier** was recently married to David W. Wright, a Virginia Polytech graduate. Beverly is very happy in her new job as a math teacher at an independent school in Hockesssin, Del. David is a chemical engineer with W. L. Core. . . . **James Hasse** tied the knot with Kathryn Brown, Wellesley '81, last August 29. He works with Dupont in Houston, while she is a marketing trainee with IBM. "We have an Explorer Post which keeps us busy backpacking, climbing, canoeing, and kayaking." . . . **Thomas Mackay** and Teresa Kostecki, Simmons '79, were married in October 1980. Thomas spent 18 months of training to be a naval flight officer in Pensacola, Fla., and Whidbey Island, Wash., then joined Attack Squadron 115 in Japan. "We are based aboard the aircraft carrier *USS Midway*, homeported in Yohosuka, Japan, flying the two-seat all-weather A-6 Intruder. Since joining the squadron in April '81, I've visited Australia, the Philippines, Korea, Hong Kong, and Thailand. I'd love to hear from any old Burton Four buddies. My address is LTJG Tom Mackay, VA-115, FPO SF 96601." . . . **John Wozniak** was married on March 22, 1981, to Brenda Franey, a veterinary student at the University of Florida. John will get his master's from Florida in electrical engineering-biomedical this spring. He also works as a biomed engineer at the veterinary school. . . . **Susan Jane (Morris) Colley** is still in Boston. She's a third-year grad student in math at M.I.T. In July 1980, Susan married William C. Colley III, who got his master's in electrical engineering from the 'Tute in February 1981. She reports that they are "sublimely happy, at least most of the time, and are living just across the Charles in Back Bay."

William Rust is with the Union Pacific. . . . **Michele Buchwald** is currently on maternity leave from John Hancock Mutual Life, following the birth of Benjamin last July (reported in a previous column). Benjamin's daddy is Gary Buchwald '76. Michele attained associateship in the Society of Actuaries in November of 1980. . . . **Ann Steven** is back in her hometown, New Orleans, where she has been working since graduation for the city's Office of Transit Administration, a division of the Mayor's office. "Lots of interesting work. I am a project manager for a study investigating light rail, and have worked on projects including the 1984 World's Fair and the Cable Suspended Transit System (killed by Reagan)." Ann is also in the University of New Orleans M.B.A. program, but is applying to other grad schools in civil engineering for the fall of '82. **James Rogers** just finished his graduate degree at M.I.T. in August 1981, and is working for the Aerospace Corp. in Los Angeles. . . **Al Schauer** is working on a Ph.D. in molecular genetics in Ann Arbor, but misses Cambridge and Boston. Asks Al, "Is Proposition 2 1/2 as bad as they say?" . . . **Ellen Kozak** writes, "My recent activities: 1981—'Centervideo' exhibit at the American Center for Artists and Students, Paris, France, and at Koelnistke Kunstverein, Cologne, Germany; 1980-81—artist in residence at the Massachusetts College of Art, Boston, Mass.; 1980—Eventworks '81' exhibit at the Massachusetts College of Art; 1980—exhibit at the Helen Schlein Gallery, Boston, Mass."

Your faithful secretary is sitting here listening to a six record set of Johnny Mathis making believe that she's pulling an all-nighter at the typewriter. Hope to hear from YOU soon.—**Sharon Lowenheim**, Secretary, 131 E. 83 St., Apt. 2G, New York, NY 10028

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A few words from the West Coast. **Ricardo Sitchin**, **Tom Griffin**, and **James Bader**, after finishing the Chemical Engineering Practice School last spring, have joined Chevron Research Co. in Richmond, Calif. (home of the Hell's Angels). Ricardo is living in Marin County while working on the design of a viscosity index improver plant. Tom has been assigned to the Chevron shale oil project, or "Turn Colorado into Oil." . . . Also just out of Practice School is **Charlene Chuang**, who is doing reservoir simulation and design for a firm in San Francisco.

I ran into **Phil Zylberman** in San Francisco a few months ago. He was out from the Chevron refinery in Perth Amboy, N.J., and here on special assignment to Standard Oil of California's corporate engineering staff. . . . **Clif McFarland**, after spending three months in Europe this past summer, came out here as a permanent member of Socal's corporate engineering staff. . . . I ran into **Allan Strong** in Sausalito; congratulations are in order for he and his bride-to-be, Ms. Rice, who will be married in December 1981.

As a finish line judge at the Head of the Estuary in Oakland, Calif., I picked out one very familiar voice off the water, that of **Paul Weiss**. Paul is coxswain for the Berkeley alumni oarsmen and is working on his Ph.D. there as well. . . . **Mark Vershel** is working for Intel, and living in the area of Silicon Valley. When asked how he felt about Intel's recent request to its salaried employees to put in a 50-hour work week, he said he really didn't seem to mind as his work was interesting. I hope that idea doesn't catch on around here. As for me, I'm still hopping the cable car to work every day, and I have recently been placed in charge of technical service and marketing support for crankcase oils. Fellow classmates, do keep in touch.—**Debra A. Utko**, Secretary, 1730 Sacramento St., #8, San Francisco, CA 94109

Technology and Policy: Welcome to the Activists

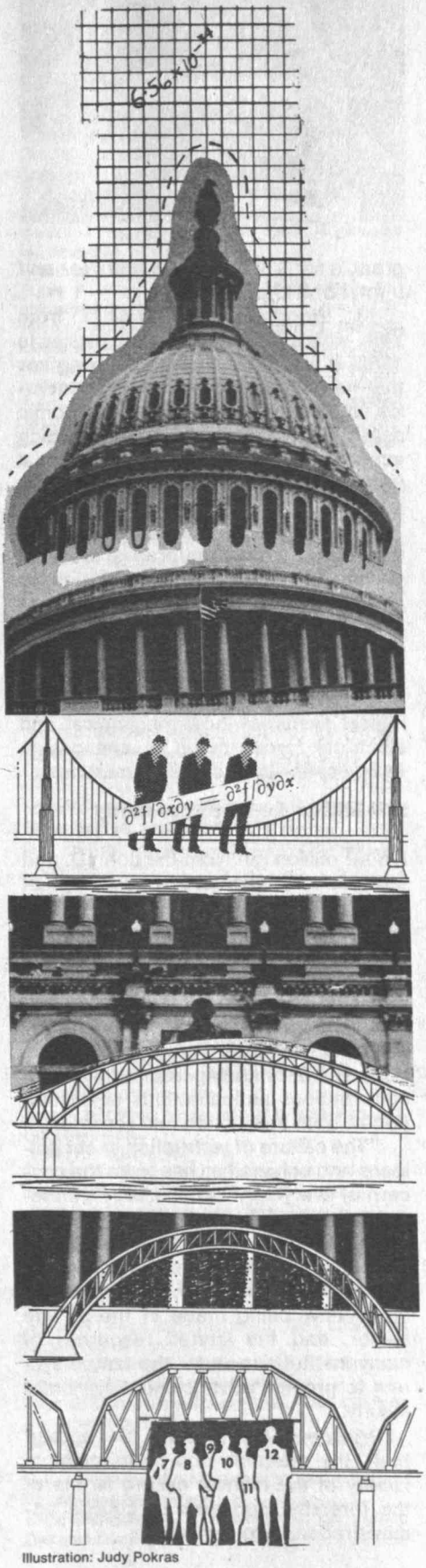


Illustration: Judy Pokras

It's a special place for "risk-takers," says Professor Richard de Neufville, '60, of the Technology and Policy Program which he founded six years ago and of which he still serves as director.

"Most people who go into it are activists," he says: they want to know technology, but they aren't satisfied without also understanding the policy-making that will make it happen.

TPP is now taking stock of its accomplishments and planning its future, and everyone is bullish: the program "is doing so well that it is serving as a model for others," says Professor Joel Clark, Sc.D.'72, of the Department of Materials Science and Engineering who serves as TPP's assistant director.

To earn master's degrees in technology and policy, students must demonstrate competence in three areas: a chosen field of science or engineering, systems analysis and economics, and law and political processes. To meet these requirements, most students end up with about 50 percent more credits that the minimum for a master's degree—a tough, two-year experience, says Professor de Neufville.

And therein lies one of the special qualities of TPP.

A World Less Tidy Than They'd Like

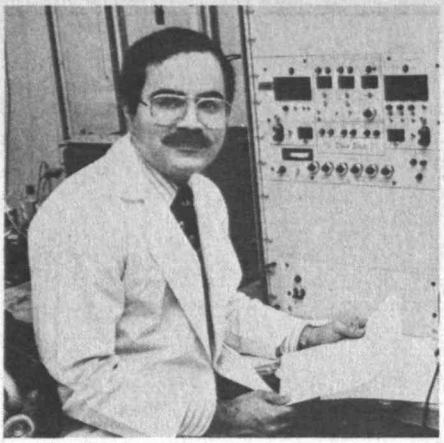
At many schools, people who study technical material are in a technical department and students with policy interests reside elsewhere. The Technology and Policy Program tries to avoid this split. Its students are based in the engineering departments that correspond with their technical interests, and many work on sponsored research after their first semester in the program. At the same time all of them actively pursue policy issues, beginning with a required course called The Policymaking Process developed and taught by Professor Martha Weinberg of the Department of Political Science. Professor Weinberg herself worked in state government for several years before coming to M.I.T., and she is keenly aware of the reality that "all the great ideas we develop in academe don't work in the public sector." Why? Because, she says, of "the incredible complexity of the environment in which policy decisions are made."

So her policymaking course focusses on questions like: What is a public problem? How are decisions on public problems made? How do we know when a public policy is successful? The tendency is for students with technical backgrounds to attempt to solve policy problems using only technical data, overlooking political realities; those lacking technical expertise tend to ignore questions of engineering feasibility issues. Professor Weinberg's goal in her course is to widen the perspectives of both these groups. "Many of the students began to understand," says Professor Weinberg, "that the world in which they are going to work is not quite as tidy as they might like it to be."

The Increasing Connectedness

Professor de Neufville thinks TPP's program to prepare students with strong technical foundations and a competence in dealing with policy issues responds to the concerns voiced by President Paul E. Gray, '54, at his inauguration in October, 1980: "What is needed is not a retreat from science and technology but a more complete science and technology. We must strive to develop among ourselves, among our students, and in the public at large, an understanding of the fact that engineering and science are, by their very nature, humanistic enterprises."

Some 20 percent of the program's graduates go on to advanced degrees, but most go to work in policy analysis positions in government or private consulting firms. Since most are activists, Dr. de Neufville feels that most will continue to choose jobs over further education. He's confident that TPP graduates will continue in demand. "The increasing connections between technology and national issues create a demand for persons qualified in both engineering and policy," he says.—*M.L.*



A stunning surprise for Dr. Raphael C. Lee (left) and Michael D. Woodford on Friday, November 13: they—and Richard Mulligan, whose photograph is not available—had been named MacArthur Prize Fellows and each would receive grants of some $150,000 during the next five years. Mr. Woodford, who has a law degree, is a graduate student in economics; Dr. Lee, who practices surgery at Massachusetts General Hospital, is studying how cells respond to electrical and mechanical forces as an affiliate of the Department of Electrical Engineering and Computer Science.

Three Unexpected Telephone Calls Yield $450,000 for MacArthur Fellows

J. Roderick MacArthur, a director of the Chicago-based John D. and Catherine E. MacArthur Foundation, made three calls to M.I.T. on Friday, November 13, and for the three recipients the stigma attached to that date must now be a fiction.

For each of them Mr. MacArthur had good news: they were among 19 "exceptionally talented individuals" chosen by the foundation to receive awards of about $150,000 during the next five years. None had applied for the money, and for all three the news was wholly unexpected.

"I was shocked," said Michael D. Woodford, a second-year doctoral student in economics who will receive $28,000 in 1982 and a total of $148,000 over the next five years.

In addition to Mr. Woodford, the M.I.T.-based MacArthur Prize Fellows are:

☐ Richard Mulligan, '76, a postdoctoral fellow in the Center for Cancer Research and a fellow in medicine at the Harvard Medical School, whose grant is for $28,000 in 1982 and a total of $152,000.

☐ Raphael C. Lee, Sc.D.'77, a research scientist in electrical engineering at M.I.T. who is a surgeon on the staff of Massachusetts General Hospital; his grant is for $32,000 in the first year and a total of $172,000.

Mr. Woodford came to M.I.T. from Yale, where he received a law degree in 1980. It was while he was studying law that he realized his interest in economics, and now he's working on economic aspects of the law—a new field in which economic theory is applied to such legal problems as corporate, antitrust, and tax law.

Dr. Mulligan, who holds a biochemistry degree from Stanford, is studying genes that control immune responses and other issues in mammalian genetics. Dr. Lee, who is specializing in plastic reconstructive surgery at Mass. General, works at M.I.T. on electromechanical and physiochemical processing in biological systems—how mechanical and electrical forces result in changes in cells, especially in cartilage materials.

$1.2 Million for a Professorship

A $1.2 million gift from the John D. and Catherine T. MacArthur Foundation of Chicago will be added to M.I.T.'s endowment in support of faculty salaries, with the field and duration of the resulting chair yet to be announced. John E. Corbally, president of the foundation, said that nine grants to as many research universities were in recognition of their "outstanding reputations and contributions as institutions of distinction to both instruction and research.

"The calibre of instruction in our colleges and universities has to be the concern of everyone," Mr. Corbally's statement said. He cited three current threats which motivated the MacArthur Foundation's gifts: the erosion of faculty salaries due to inflation, the high salary offers now being made in the private sector, and the limited resources of many institutions under the tenure system to provide advancement for junior faculty.

President Paul E. Gray, '54, agreed that "the retention and recruitment of faculty of the highest calibre is one of the foremost concerns of college administrations everywhere."

Still Time to Buy a Chair in 10-250

There are five months for alumni to underwrite chairs in the refurbished Huntington Hall (Room 10-250). At $2,000 each they're a bargain, thinks Mary K. Kyger, assistant director of the Alumni Fund.

Huntington Hall, which carries the name of the original lecture hall in the Rogers Building in Boston as a result of early benefactions by Bostonian Ralph Huntington, was completely refurbished in 1977 as a project of the Alumni Fund. Since then, over 75 percent of the seats in the hall have been underwritten by alumni, whose names (and an inscription of their choice) then appear on the appropriate seats. The account will be closed on June 30, with the Alumni Fund underwriting any remaining seats. Fewer than 100 are now available.

Three ways to add to your name in Huntington Hall:

☐ Give cash or securities of $2,000.

☐ Pledge $400 or more for each of up to five years, to make a total of $2,000.

☐ Give or pledge $1,000 for up to five years, with a corporate matching gift program pledged to add $1,000.

Sanborn C. Brown, 1913-1981: Scientist, Historian, Philosopher

Professor Emeritus Sanborn C. Brown, Ph.D.'44, who taught physics at M.I.T. from 1938 until his retirement in 1975, died in Henniker, N.H., on November 28, 1981. He was 68.

Professor Brown's interest in plasma physics was supplemented by a lively concern for the history of science—he was a leading authority on the colonial scientist Benjamin Thompson, known

as Count Rumford—and for the relationship between science and religion; he was an active member of the Unitarian-Universalist Association and a founding member of the Institute for Religion in an Age of Science.

Professor Brown's major contributions to physics were in plasma science, in which he collaborated with Professor Emeritus William P. Allis. Later he became active in developing new science teaching methods and was a leader in two international conferences on physics education. He was the author of several basic guides in the field of plasma physics and of three books on physics education.

Professor Brown came to M.I.T. in 1937 after receiving two degrees in physics from Dartmouth. He held the distinguished service citation of the American Association of Physics Teachers and had positions of major repsonsibility in plasma physics and physics education in the International Union of Pure and Applied Physics. His interest in education led to Professor Brown's appointment as associate dean of the M.I.T. Graduate School in 1963, a post which he held for 12 years.

Meanwhile, Professor Brown also was studying the life and works of Benjamin Thompson, a prolific eighteenth-century American scientist who worked chiefly in Concord, N.H. but later became a Count of the Holy Roman Empire while in the service of the Elector of Bavaria. His three books on the subject established Professor Brown as the leading authority on Mr. Thompson and his works.

The breadth of Professor Brown's interests were also apparent in his leadership in several Unitarian-Universalist conferences on science and religion, in his book on *Wines and Beers of Old New England* (winemaking was a major hobby), in his recent activity as a member of the board of the New Hampshire Solar Energy Association, and in his new work—as yet unpublished—on the history and design of fireplaces.

Deceased

J. Russell Jones, '03; 1981; Highland Hills Dr., Halifax, Va.
Pearl K. Andrews, '16; November 10, 1981; Belmont Mann Nursing Home, 34 Agassiz Ave., Belmont, Mass.
Dustin W. Wilson, '17; September 20, 1981; 2720 Fairmount Blvd., Cleveland, Ohio.
William P. Fisher, Jr., '18; June 1981; 2304 Riddle Ave., Apt. 408, Wilmington, De.
Albert Mayer, '19; October 14, 1981; 240 Central Park St., New York, N.Y.
James R. Moore, '19; October 16, 1981; The Hillsboro Club, Pompano Beach, Fla.
Edward E. Scofield, '19; August 9, 1981; West 450 15th Ave., Spokane, Wash.
Archibald H. Kinghorn, Jr., '20; August 18, 1981; 1002 Trillium Lane, Mill Valley, Calif.
Herman Broockmann, '21; November 8, 1981; 5181 Tigua Dr., Tucson, Ariz.
Walter W. Boyd, '22; October 22, 1981; 6740 Wilson Lane, Bethesda, Md.
Abraham I. Kaye, '22; August 7, 1981; 400 Gold Isles Dr. #4, Hallandale, Fla.
Samuel H. Manian, '22; November 1, 1981; Box 600-E Adamsdale Rd., North Attleboro, Mass.
Arthur F. Rogers, '22; June 1981; 2015 N. 31st Ave., Hollywood, Fla.
Harold P. Stanley, '22; February 6, 1977; 693 Somerset Ave., Taunton, Mass.
Edward L. Winslow, '22; August 12, 1981; Dennis Bayside, PO Box 993, Dennis, Mass.
Samuel L. Williams, '23; September 18, 1981; School St., Enfield, N.H.
Paul H. Caskey, '24; April 1981; 1612 Sprucewood, Rockford, Ill.
Willard I. Gideon, '24; March 1981, 2700 S Joyce St., Arlington, Va.
Donald O. Kennedy, '24; October 27, 1981; 10848 Connecticut Ave., Sun City, Az.
B. Wissler Partlow, '24; 1980; PO Box 2477, Staunton, Va.
Horace C. Ruggles, '26; June 9, 1981; 75 Prospect St., Amityville, N.Y.
Frederick E. Walch, '26; 1981.
Roger W. Purssell, '28; November 8, 1981; 837 Birchwood Dr., Orange, Conn.
Hirsh W. Sulkowitch, '28; September 19, 1981; 45 Eastern Prom, Apt. 2C, Portland, Maine.
Paul F. Nocka, '29; September 1, 1981; Green St. At Royall, Canton, Mass.
Byron L. MacKusick, '30; September 10, 1981; 835 Jewett St., Woodstock, Ill.
Norman E. Blaisdell, '31; 1976; c/o Thomas Moncure, 121 S. Royal St., Alexandria, Va.
John Page, '31; October 16, 1981; 19606 Hebron Rd., Harvard, Ill.
Mrs. Harold S. Wilkins, '31; April 22, 1981; 50 Snake Hill Rd., Belmont, Mass.
Robert H. Hubbell, Jr., '32; June 1981; Kiawah Island, PO Box A118, Johns Island, S.C.
Donald I. McSheehy, '32; May 1980; 514 Mooney Rd., Ft. Walton Beach, Fla.
Quintin P. Peniston, '33; September 23, 1981; 23859 Newell Lane, NE, Kingston, Wash.
Bruce B. Whitney, '33; November 14, 1981; 8309 E. Orange Blossom Lane, Scottsdale, Ariz.
Gerard Degelder, '35; June 18, 1981; 1467 Algonquin Rd., Des Plaines, Ill.
Frederick Pruyn, Jr., '35; 1979.
Leonard N. Leum, '36; February 4, 1979; 8401 Peters Rd., Frederick, Md.
Louis E. Pepperberg, '37; October 2, 1981; 1431 Green Bay Rd., Highland Park, Ill.
G.P. Villaflor, '37; June 7, 1981; Hibernia Rd., Salt Point, N.Y.
Allen R. Cherry, '38; September 12, 1981; 2070 Canterbury Rd., Westlake, Ohio.
Frederick G. Crabb, Jr., '40; October 12, 1981; 264 Belhaven Circle, Santa Rosa, Calif.
Marshall E. Greenspon, '40; October 1981; 9615 Cottrell Terr., Silver Spring, Md.
John G. Kelley, '40; April 1979; 111 Hill Dr., Kentfield, Calif.
Edward A. Eve, Jr., '41; October 28, 1981; 45 N. Glen Woods Rd., Gales Ferry, Conn.
Henry Faul, '41; September 16, 1981; 4701 Pine St., Philadelphia, Penn.
Russell H. Lamb, '41; October 30, 1981; Box 147, Leicester, Mass.
Albert F. Gallatin, '43; 1979.
Sanborn C. Brown, '44; November 28, 1981; Hemlock Corner, Henniker, N.H.
Wallace H. Garrett, Jr., '46; September 19, 1981; 5003 Portsmouth Rd., Fairfax, Va.
Kenneth M. Haber, Jr., '47; October 17, 1981; 16500 Parkland Dr., Cleveland, Ohio.
Bruce R. MacRae, '47; July 18, 1981; 800 Asbury St., New Milford, N.J.
H. Stuart Dodge, '51; October 10, 1981; 5259 Vista Miguel Dr., La Canada, Calif.
Gerald R. Doherty, '51; November 18, 1981; 108 Edward Foster Rd., Scituate, Mass.
John G. Maris, '54; February 1981; 1562 Lewiston Dr., Sunnyvale, Calif.
Allen Kezer, '56; August 24, 1981; 36 Oakridge Rd., Wellesley, Mass.
John N. MacRae, '67; November 13, 1981; 34 Eliott St., Jamaica Plain, Mass.
Rena E. Ganzberg, '77; November 12, 1981; 268 N. Crescent Dr., Beverly Hills, Calif.

The Arts: "More at Home in the Bustle of Main Street"

What course for the Council for the Arts at M.I.T. in the next decade? President Paul Gray, speaking at the ten-year anniversary meeting of the council late last year, said the answer must be based on three premises: that M.I.T. is a special kind of university; that the arts represent a special kind of intellectual social interaction; and that the alliance between education and the arts needs a special support structure.

M.I.T. is unique, said Dr. Gray, because it has a direct, ongoing interaction with the world. That aspect of the Institute has its roots in William Barton Rogers' concept of "learning by doing." This commitment, together with M.I.T.'s extraordinary relationship between education and research, means that the Institute is remarkably responsive to the changing needs of society.

The arts represent a special interest that reflects the changing culture, and the unique character of M.I.T. means that the arts should—and do—have particular relevance here. Furthermore, said Dr. Gray, as the communications revolution transforms society, it also transforms the way the arts and culture are disseminated and absorbed.

Four attributes are needed for arts in the academic setting, said Dr. Gray:

☐ Funding (new ideas are best accepted when they pay for themselves).

☐ Committed people to provide advocacy and advice.

☐ A two-way flow of fresh ideas—to invigorate existing programs and to provide new links to dissimilar programs.

☐ Maintenance of high standards, just as in any other intellectual effort.

"Continue to be bold," he told the audience. "You are a catalytic group. Continue to act, continue to be dynamic. The arts need M.I.T. just as much as M.I.T. needs the arts."

Paraphrased excerpts from other speakers at the Council's meeting last fall:

☐ Henry A. Millon, dean of the Center for Advanced Study in Visual Arts of the National Gallery of Art, Washington, D.C. (Mr. Millon is also a visiting professor at M.I.T. in the Department of Architecture): Only the arts (literature, music, theater, dance, visual arts) seem to retain their ability to speak with immediacy of the concerns in life today.

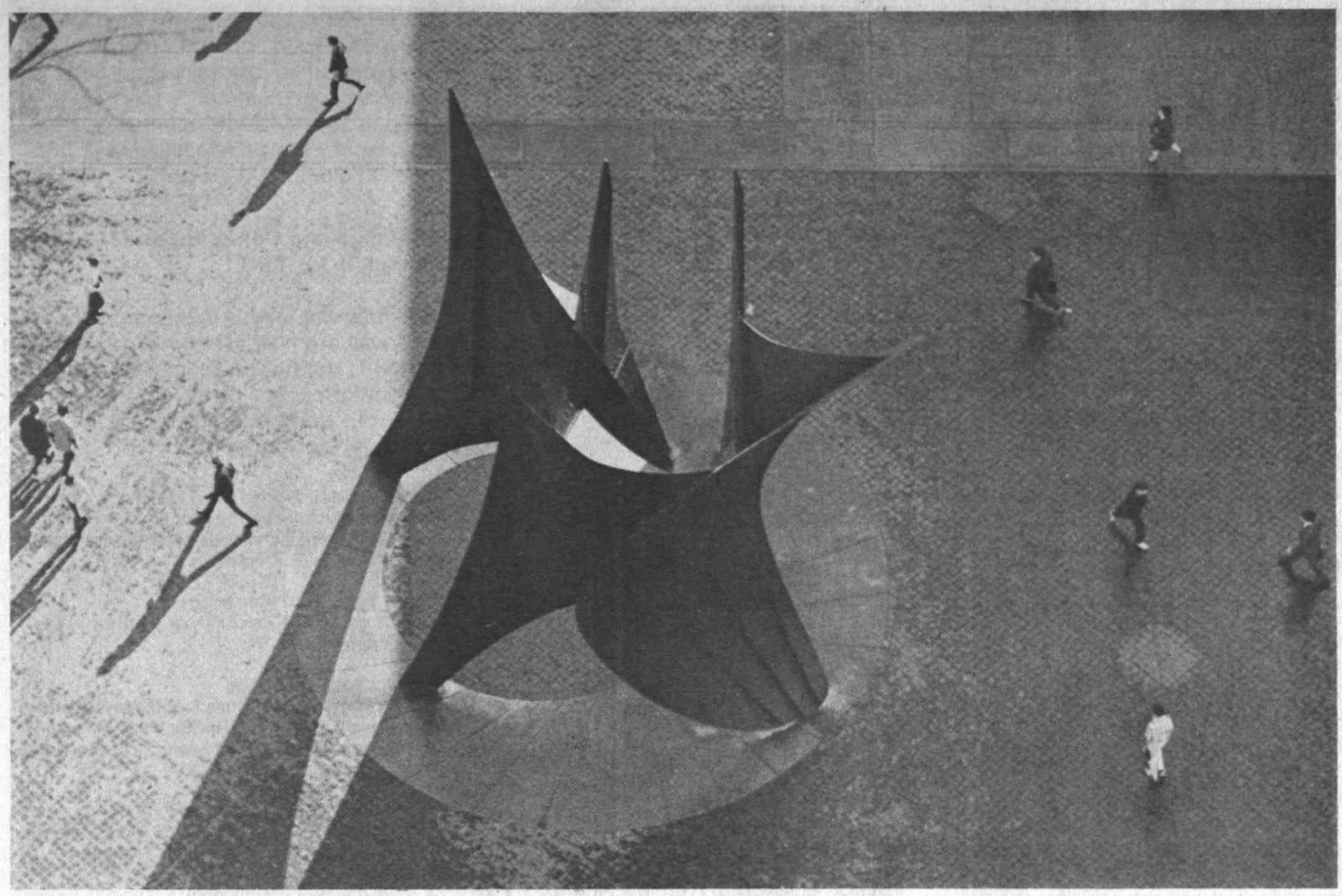
The laboratory demonstrates hands-on experience in learning. In the arts too, the linking of thought with motor activity is explored. Laboratory and studio subjects form the eye-mind-hand into a well-coordinated triumvirate.

Each art object has caught within it observations about its maker and information about the culture in which the work was done. The language used by artists is different from the verbal, mathematical, and science language. Yet it is equally valid in learning about ourselves and that which is outside ourselves. There is an intriguing parallel between the origin of language and that of art. A mode of discourse was developed as a consequence of learning to think—both verbally and visually. How can I know that I know what we're thinking until we see the results of what we have done.

We always admire the mind that moves freely and effectively in more than one mode of thought. All curricula should require contact with an array of realms of thought: verbal, mathematical, visual, musical, and those that require mind-eye-hand in unity. We must strive to emphasize acquisition of varied languages that operate in all our brains.

The idea that the visual arts can be eliminated first when educational budgets are to be cut must itself be eliminated. The arts should be treated seriously. The making and performing of arts should be one of the bases of our educational system.

☐ President-Emeritus Jerome B. Wiesner, chairman of the Council on the Arts: To communicate we have to have a common language. "When we com-



municate, we have a complete system: mouth and ears. But we *mostly* use our eyes, and in this case we don't have an *output* device."

☐ Walle Nauta, Institute Professor and professor of neuroanatomy: The relationship of art and the brain is complex. It has been very clear to most that art would not have its peculiar power if it were no more than explicit reproduction. Nature tells no stories; only artists tell stories—by measuring the distance between matter and mind.

The artist must leave much unsaid—an essential tool of the poet is *allusion*—art's incomplete sentences provide little more than is needed to unfreeze the string of our fantasy.

It is interesting to speculate: What was it like for the first human creatures when they observed lines scratched on a cave wall? The particular flow of lines irresistably elicited the memory of a buffalo hunt, but the lines in no way smelled like buffalo.

It is clear that the brain contains complex systems to analyze and extract features of the world around us. The world as a purely sensory event is incomplete, because the brain can create images of its own, without the input of the senses. The purest example is the psychotic patient's hallucinations: they are shocking; we will say hallucinations are a product of the disordered mind. But you and I spend at least one hour each day hallucinating when we dream—and our dreams are indistinguishable from hallucinations. Dreams have accompanying anxiety that is no less than the emotions generated by real situations.

The content of dreams is usually too symbolic and removed to be of direct utility. But there are some exceptions—a chemist, after pondering an organic compound, found the answer in a dream in which six snakes formed a circular chain: dybenzedrine. Thought in the brain is no less active during sleep than waking, but activity favors an internal mechanism—the brain becomes introverted during sleep.

Dreams are pure imagination—seeing or hearing things not contained in an incoming sensory network. But it is *not* necessary to be asleep to have imagination. Most people share the experience that new thoughts come mostly when doing something monotonous (raking leaves in the yard, perhaps). Or some have the experience of saying something while teaching that they didn't know they understood: it comes rolling off your tongue and you hear yourself saying something for the first time *yourself*. The more I think, the more I'm tempted to say imagination is the product of good habits—like being in the right place at the right time. A.A. Milne's Winnie the Pooh explains to Piglet: "It isn't so much that I get the bone, it's that the bone gets me. So I must be in a place where the bone can find me."

☐ Francis Low, Provost: I think the separation between sciences and art is artificial. The appreciation of a remarkable equation in science is similar to the appreciation of a great work of art.

☐ Stanley Kunitz, a poet who is a charter member of the Council for the Arts at M.I.T.: All the great acts of imagination are unifying. All creation is a continuous tissue whose filaments are interconnected—making a great web. If we touch the web at any point, the whole web shatters. If we believe that, we have an absolutely basic concern for the community of fellows on this planet—whatever happens on the planet concerns you.—*M.L.*

A potter's wheel in the Student Art Association and Alexander Calder's "Great Sail" in McDermott Court—two examples from M.I.T. of the truism stated by Professor Francis E. Low, provost, to the members of the Council for the Arts at M.I.T. late last year: "The separation between the sciences and art is artificial," Dr. Low declared. (Photos: left, Jeffrey Mogul, '79; right, M.I.T. Museum)

Sea Grant: Search for a New Head

Dean A. Horn, N.E.'49, who has been associated with the M.I.T. Sea Grant Program since its inception in 1970 and its director since 1976, will leave that post next July and will retire from the Institute on February 1, 1983. Mr. Horn has been a major factor in the growth and success of the program; Professor Kenneth A. Smith, '58, vice-president, spoke of his "unflagging enthusiasm" and "remarkable organizational skills."

A search committee chaired by Professor Ira Dyer, '49, chairman of the Sea Grant Faculty Committee, is searching for a new director.

Sustaining Fellows Fund: Automated Library Circulation

The Sustaining Fellows Fund—the accumulated unrestricted gifts from sustaining fellows—will be devoted at least through 1982 to providing an automated circulation system for the M.I.T. Libraries, according to a decision made by President Paul E. Gray, '54, late last year.

Jay K. Lucker, director of libraries, calls it "the single most important step the libraries have taken. It will have important implications for years to come."

In summary, the new system—utilizing bar code labels like those appearing on supermarket grocery items—will manage all circulation processes automatically: checking out books, recalling them, issuing overdue notices and accounting for fines, and placing books on reserve. Later the same basic system may be associated with an on-line computerized card catalog and eventually an integrated bibliographic control system.

The $177,000 in the Sustaining Fellows Fund at the end of last year will be supplemented by donations to the fund during the current year, and the automated circulation system should be in operation by late in 1983. Since the project could not be funded through the "normal budget process," says President Gray, "the Sustaining Fellows Fund was a real blessing."

Dalton Award to Parker

Hugh Parker, '43, is the 1981 recipient of the Marshall B. Dalton ('15) Award, recognizing exceptional service to M.I.T. by a member of the Corporation Development Committee.

The announcement was made at the C.D.C. meeting on October 30 in Mr. Parker's absence. He is a long-time resident of London, a senior director of McKinsey and Co., Inc.

In his tribute, Howard W. Johnson, chairman of the Corporation, described Mr. Parker's "rare dedication—unselfish and unswerving devotion" to M.I.T. He was "among the first to add an international dimension to the Industrial Liaison Program," said Mr. Johnson—"an important Institute emissary to the growing number of British firms who have become members of the program." In addition, Mr. Parker has been president of the M.I.T. Club of London since 1969 and a member of the Educational Council for the past two years.

S. Picardi

R. Knight

Picardi to be Alumni Secretary as Richard Knight Plans Retirement

Shirley M. Picardi, Ph.D.'76, who has been at M.I.T. since entering the Graduate School from Radcliffe in 1970, will become secretary of the Alumni Association next July 1 upon the retirement of Richard A. Knight, '47.

Dr. Picardi holds master's (1972) and doctor's degrees from M.I.T. in food science and technology, and last year as a Sloan Fellow she received a master's degree from the Sloan School of Management. In the meantime, from 1976 to 1979 Dr. Picardi was an industrial liaison officer at the Institute, serving as the M.I.T. interface with 21 major American and Canadian firms and managing the Industrial Liasion Office's publications programs.

Since completing her work as a Sloan Fellow last June, Dr. Picardi has been a special assistant to the vice-president for resource development. Her appointment was made by the Alumni Association's Board of Directors and announced by Angus N. MacDonald, '46, president of the association. Dr. Picardi is the nineteenth secretary of the association, the first woman to hold that post; between now and July she'll be working with Mr. Knight to assure an effective transition of the secretary's responsibilities.

Upon retirement next summer, Mr. Knight will resume an association with Heath Corp. of Milwaukee, a management consulting firm with which he worked before joining the Alumni Association in 1972.

In announcing Mr. Knight's impending retirement, William J. Hecht, '61, executive vice-president of the Alumni Association, paid tribute to "his dedication, especially his determination to strengthen the relationships between students and alumni." Mr. Knight's "caring for M.I.T. is boundless," said Mr. Hecht, "and he has given new directions to alumni programs."

Meetings and Conferences Schedule for 1982

The following major meetings and conferences are now scheduled to be held at M.I.T. during the year 1982. For further information, write to Joseph J. Martori, associate secretary of the Alumni Association, Room 10-115M.

March 13, 1982 (Rochester)
Rochester Technology Symposium "A Survey of Technical Strengths in the Rochester Community Fostered by M.I.T. Alumni"

March 24-26, 1982 (Cambridge)
Second conference on computer graphics in CAD/CAM systems

April 3, 1982 (Cambridge)
"Navigating Changes—How to Manage Career and Professional Growth and Redirections" Sponsored by AMITA and the Boston Chapter of the Society of Women Engineers. (Open to all.)

April 14-16, 1982 (Cambridge)
"Two-Phase Thermal Hydraulics: Fundamentals, Computer Codes and Nuclear Applications"

June 10-11, 1982 (Cambridge)
Technology Day

June 14-17, 1982 (Cambridge)
Power electronics specialist conference

June 15-17, 1982 (Cambridge)
Conference on the macroengineering approach to managing large-scale technological development

June 17-20, 1982 (Cambridge)
Annual conference of the American Humanist Association

June 21-25, 1982 (Cambridge)
"Advances in Finite Element Methods in Structural Mechanics III"

June 24-27, 1982 (Cambridge)
"First National Conference on Black Administrators at White Campuses" Sponsored by the Association of Black Administrators at M.I.T.

August 2-5, 1982 (Cambridge)
Third international conference on the behavior of offshore structures

August 9-20, 1982 (Cambridge)
"Port Management and Operations" The first of two mini courses which may be taken back to back.

August 23 - September 3, 1982 (Cambridge)
"Port Planning and Design"

August 18-22, 1982 (Cambridge)
Research conference of the International Federation of Organic Agriculture Movements

September 24-25, 1982 (San Francisco)
M.I.T. Alumni Officers Conference (West)

October 2-3, 1982 (Cambridge)
"Electrical Engineering 100th Anniversary"

October 8-9, 1982 (Philadelphia)
M.I.T. Alumni Officers Conference (East)

Courses

Robert J. Schwinghamer, S.M. '68 (right), receives the NASA Outstanding Leadership Medal from James M. Beggs, NASA administrator, for his work on the first Space Shuttle mission. (Photo: NASA)

I
Civil Engineering

Willard E. Simpson, Jr., '40, writes, "After serving nearly four years in the Engineer Corps of the U.S. Army—nearly 3½ years of which were overseas in the Middle East during World War II—I joined my late father W.E. Simpson's ('05) consulting firm in 1946 in San Antonio, Tex. Having been executive vice-president of this firm since my father's death in 1967, I was elected president in January 1981. My one year in the Graduate School of M.I.T. will forever remain one of the most enlightening and rewarding experiences of a lifetime. Next to my undergraduate years at Texas A&M University, it was the greatest. (Albeit my classroom record was no evidence of achievement.)" . . . **Daniel Brand,** S.M.'58, reports, "I was promoted to vice-president of Charles River Associates, a Boston economics consulting firm, in charge of the urban transportation practice. Interesting projects are everywhere in this era of cutting back public subsidies for mass transit systems."

Clement Mesavage, Jr., S.M.'79, has been named national director of technical services for the Independent Liquid Terminals Association, representing 250 chemical and oil tank storage facilities worldwide. . . . **Kentaro Tsutsumi,** S.M.'38, is currently a professor of civil engineering at Tufts University, Medford, Mass. . . . **Ronald E. Nece,** Sc.D.'58, writes that in 1980-81 he was chairman of the Hydraulics Division of the American Society of Civil Engineers and he is now (1981-82) president of the Seattle, Wash., section of the society.

Roger Arndt, Ph.D.'62, reports, "I continue to be director of the Saint Anthony Falls Hydraulic Laboratory at the Univeristy of Minnesota with research activities in hydropower, cavitation, and aeroacoustics. I lectured in mainland China from September 1980 to October 1970 on cavitation as a guest of the Water Conservancy and Hydroelectric Power Institute. Invited lectures on hydropower took me to Ecuador and Thailand in 1981." . . . **William B. Preston,** S.M.'65, has been named an executive vice president of Henningson, Durham & Richardson, Omaha, Neb., an architectural, engineering, systems and science firm. He joined the firm in 1969 and since then has had extensive experience in project management and client liasion; he is in charge of project development.

Robert Broughton, S.M.'59, writes that he "continues to work as a professor of agricultural engineering at McGill University, Montreal, Quebec, Canada. This year I was named a fellow of the Canadian Society of Agricultural Engineers and was given honorary life membership in the Corrugated Plastic Tubing Association for my research and teaching contributions to the land drainage industry in the United States and Canada." . . . **David Kim Taylor,** S.M.'81, reports, "After returning to M.I.T. to complete one degree and obtain another, I took the position as systems coordinator for CM, Inc., an international construction management firm for whom I have travelled extensively." . . . **Richard M. Simon,** Ph.D.'72, has been named an associate of Goldberg-Zino & Associates, Inc., Newton Upper Falls, Mass. . . . **Hayrettin Kardestuner,** S.M.'57, has completed travel through China and Russia, "sharing information on mathematical theory with many Asian scientists," and returned to teaching at the University of Connecticut. During his stay abroad, he was invited by the People's Republic of China to organize one of the nation's first symposia on mathematical theory and was awarded two honorary degrees.

II
Mechanical Engineering

Wayne J. Book, Ph.D.'74, associate professor at Georgia Institute of Technology, is currently a visiting scientist at the Robotics Institute of Carnegie Mellon University. . . . **Lawrence M. Cohen,** M.E.'80, reports that he is presently a member of the technical staff at TRW Defense and Electronics, Redondo Beach, Calif. . . . **Jon A. Andresen,** S.M.'73, is currently a systems engineer at Southern Pacific Transportation Co., with responsibility for developing a track maintenance planning system.

Frank J. Heymann, S.M.'53, writes, "I am with Westinghouse Steam Turbine-Generator Division and have recently completed a three-year term as chairman of the American Society for Testing and Materials' Committee on Terminology; active in ASTM Committee G-2 on Erosion and Wear since 1964; and received ASTM's Award of Merit in 1976."

Frederick G. Crabb, Jr., S.M.'40, of Santa Rosa, Calif., passed away on October 12, 1981; no details are available.

III
Materials Science and Engineering

H. Kent Bowen, Ph.D.'71, professor of ceramic engineering and of electrical engineering, is now Ford Professor of Engineering at M.I.T. He was a central figure in development of the Ceramic Processing Research Laboratory, a cornerstone of the Materials Processing Center, and is now engaged in materials processing developments related to increased productivity and high-technology systems as associate director of the center and a program director in the M.I.T. Energy Laboratory.

William F. Hosford, Sc.D.'59, is co-author of a text, *Metal Forming: Mechanics and Metallurgy,* to appear in the fall of 1982. . . . **Richard E. Cole,** S.M.'52, reports that he retired from Reynolds Metals Co., on December 31, 1980.

Bruce B. Whitney, S.M.'33, passed away on November 14, 1981. He was a graduate of Amherst College (1933) and retired in Scottsdale, Ariz., following a varied career in mining. He was proud of his 50-year membership in the AIME. He is survived by his wife, Dorothy; a son, Bruce, Jr.; a daughter, Mrs. James White; five gradchildren; and a sister, Ms. Elinor Whitney.

IV
Architecture

Alvor Tabor III, M.Arch.'77, writes, that he was engaged in the "design/development of solar heating, wind energy, and conservation retrofits, as founding member of Energy Task Force, Inc., New York City, from 1976-80. Now a design engineer at Skidmore, Owings & Merrill, currently in San Francisco, Calif." . . . **Alex L. Seid,** M.Arch.'74, writes, "I am presently an architectural designer with Hugh Stubbins & Associates, Cambridge, Mass. I have previously worked with the U.N. Peacekeeping Mission in the Middle East (1979-80) and traveled to Israel, Lebanon, Syria, Jordan, and Egypt. Prior to that, I spent four months travelling the Far East after my wife completed law school including a few weeks in Mainland China, travelling from the south to Beijing (Spring 1979)."

E.C. Gildow, M.Arch.'52, reports that he became president of WGHT Architects, Planners, Interior Designers, Seattle, Wash., in July 1981—"a 50-person firm doing commercial, institutional, educational projects in the Pacific Norhtwest." . . . **Stephanie Bartos,** M.Arch.'75, writes, "I opened my own design/research firm last year, working on additions and new houses for private clients in Tuxedo Park (an historic district), New York. I serve on a peer review panel for New York state's appropriate technology grants and won (with **Vivian Loftness,** M.Arch.'75) a New York State ERDA (Energy Research and Development Agency) Passive Solar Design Award." . . . **Micheal Buckley,** M.Arch.'72, writes that he is past president of the Connecticut Society of Architects and is now president of Halcxon Ltd., a development firm with offices in Connecticut, Ohio, and California. The firm's work on Citicorp Center's commercial and public spaces won an Urban Design Award in 1980 and has received international publicity.

R.D. Gillmor, M.Arch.'55, reports that he is the founding director of the architectural program at the University of Calgary (1971-75), where he is now professor of architecture and he has been chairman of the Advisory Design Committee, National Captial Commission, Ottawa, Canada, since 1979. . . . **John G. Kelley,** M.Arch.'40, of Kenfield, Calif., passed away in April, 1979.

V
Chemistry

Mark S. Wrighton, a member of the M.I.T. faculty since 1972, is now Frederick G. Keyes Professor of Chemistry, succeeding Professor John Ross, Ph.D.'51, now at Stanford; he's one of the youngest persons ever to be chosen for a named professorship at the Institute. Professor Wrighton has been widely honored for research in inorganic photochemistry, catalysis, photoelectrochemistry, and surface chemistry—including advances in converting solar to chemical energy.

Charles M. Deber, Ph.D.'67, writes, "I am now associate professor of biochemistry at the University of Toronto, and a member of the senior staff of the Research Institute at the Hospital for Sick Children in Toronto. My wife, **Raisa Berlin Deber,** (Ph.D.'77) is presently assistant professor in the Department of Health Administration (Faculty of Medicine) at the University of Toronto and is cross-appointed in the Department of Political Economy at the university. We are the parents of Jonathan Arthur Debber, born in Toronto on May 25, 1981."

David A. Ucko, Ph.D.'72, science director at the Museum of Science and Industry, Chicago, is the author of a new textbook, *Basics for Chemistry* (Academic Press). . . . **Gilbert Moos,** Ph.D.'39, writes, "Chemistry has led me into cancer chemotherapy and with the help of students and financial supporters, to the curing of three kinds of mice of two kinds of cancer. Further research in this area is now almost at a standstill because of shortage of funds." . . . **James N. Little,** Ph.D.'66, has joined Zymark Corp., Hopkinton, Mass., as vice president. He has also been elected a director of Rheometrics, Inc., Union, N.J.

Jack A. Kyger, Ph.D.'40, writes, "I retired in January 1981 from breeder reactor R&D to live in sailing country on Florida's west coast with my wife, Mary Frances. Hoping for seasonal visits from snowbird children." . . . **Robert N. Nelson,** Ph.D.'69, writes, "I spent April-August 1981 as a visiting lecturer and post-doc at the University of Georgia doing laser spectroscopy with **Lionel Carreira,** Ph.D.'69. I have now returned to Georgia Southern College." . . . **David M. Hercules,** Ph.D.'57, chairman of the Department of Chemistry at the University of Pittsburgh, has been awarded the Lester W. Strock Medal of the New England Section of the Society of Applied Spectroscopy, for a 1980 paper which he co-authored on surface spectroscopy of a molybdenum-alumina catalyst.

As reported to the secretary of the Class of 1949, **Dewey J. Sandell,** Ph.D.'49, has passed away. Prior to receiving his degree at M.I.T. Dr. Sandell obtained a bachelor's degree from Montana State University. He was vice-president of Carrier Corp. . . . **Leonard N. Leun,** Ph.D.'36, of Frederick, Md., who was research chemist at the Atlantic Richfield Co. prior to retirement, passed away on February 4, 1979.

VI
Electrical Engineering and Computer Science

John C. Poulos, S.M.'77, is presently employed with Booz, Allen & Hamilton, Bethesda, Md., as a telecommunications consultant. . . . **S.J. Jatras,** S.M.'52, president and chief executive officer of the Telex Corp., has been elected chairman of the board of the firm. . . . **Robert Chen,** S.M.'68, writes, "I am managing R&D group at Hewlett Packard, working on computer terminals. I have two children now and am living in California with my wife, Mary." . . . **Paul Penfield, Jr.,** Sc.D.'60, professor of electrical engineering at M.I.T., has been named a director at Genrad, Inc., Concord, Mass., a maker of electronic and semiconductor test equipment. . . . **Robert Price,** Sc.D.'53, staff consultant, communications sciences for Sperry Research Center, Sudbury, Mass., has received the 1981 Edwin Howard Armstrong Achievement Award, given by the Institute of Electrical and Electronics Engineers, Inc., in recognition of outstanding contributions over a period of years in the field of telecommunications. Dr. Price's work has been in digital communications and magnetic recording systems, and he holds (with **Paul E. Green, Jr.,** Sc.D.'53) the patent on the first adaptive radio receiver for digital data.

Ko Muroga, S.M.'54, writes, "As president of NEC America, Inc., a wholly owned subsidary of Nippon Electric Co., Ltd., Tokyo, Japan, I have been working in the U.S. for more than three years. I found the work very challenging and the experience at M.I.T. is a great help." . . . **Donal K. Holway,** S.M.'47, is currently a sub-contractor to the Allis Chalmers Hydro-Turbine Division, Lawrence, Mass., in charge of design. He recently completed the first bulbturbines in New England and a two 8.4-Mw. units redeveloping an 1845 stone dam.

Arthur W. Robinson, Jr., S.M.'41, of Riverside, Conn., passsed away in July 1981; no details are available.

VI-A Program

By the time this article appears, the VI-A Program will be in the throes of selecting its 65th incoming class. The popularity and reputation of the program being what they are, 52 to 54 percent of sophomores apply annually, but only one out of every two applicants will finally fill this year's openings. The department had to place a ceiling of 85 on the incoming VI-A classes for three years (this will be the second of three) to try and stabilize the program at 250 to match the available faculty supervision.

The VI-A office received a copy from the publisher of an article by **Robert L. Babber,** '58, "Software Reflected: The Land of Moc," Vol. 1, No. 3, August 1981 issue of *Systems, Objectives, Solutions* (North Holland—International Journal). Bob's address is listed as: D-6380 Bad Homburg V.D.H., F.R. Germany. . . . On the East Coast to present a seminar was **John D. Chisholm,** '75, of Hewlett-Packard Co.'s computer systems division, Cupertino, Calif. Stopping by the VI-A office to visit, he took John Tucker to lunch.

A call from **John F. Cooper,** '74, informs us that John left his VI-A company, Hewlett-Packard, to work in San Francisco for Dolby Labs, on December 1, 1981. He is in charge of new manufacturing to be done there. John was married last summer and will continue to live in Palo Alto. . . . Living in Wellesley, Mass. and meeting John Tucker in town, **Thomas E. Knight,** '74, says he is still with Digital Equipment Corp., Marlboro, Mass., his VI-A company. He and his wife Susan live at 42 Cedar St., Wellesley Hills, Mass. 02181.

At M.I.T. on November 5 on alumni business, **H. DuBose Montgomery,** '71, paid Director Tucker a visit. DuBose and his wife were written up in the November 1981 issue of *Money* magazine. . . . Back from an extended honeymoon trip to Australia which included the Great Barrier Reef and outback country, **Louis A. Nagode,** '80, tells us that he's settling into his new position with Hewlett-Packard in their Colorado telecommunications division, Colorado Springs.

At M.I.T. recruiting for his company, Kodak Research Labs, was **Kenneth A. Parulski,** '80, who visited the VI-A office and took John Tucker to lunch. . . . A VI-A friend of **Brian A. Yokum,** '81, tells us that Brian is now employed with Technical Associates, New Orleans, La.

Others who have signed our VI-A guest book include: **Charles B. Dietrich,** '77, with RCA Sarnoff Labs., Princeton, N.J.; **Barry Goldman,** '76, with Touche Ross & Co., Newark, N.J.; Steven F. Labalme, '81, with Megatest Corp., Santa Clara, Calif.; **Manmoham S. Pathak,** '52, director of corporate planning for Foster Wheeler Corp., Livingston, N.J.; **David M. Ryter,** '80, with Codex Corp., Mansfield, Mass.; and **Edward C. Whitman,** '61, now with DARPA, Arlington, Va.—John A. Tucker, director, VI-A Program, Room 38-473, M.I.T., Cambridge, MA 02139

VII
Biology

Stephen Raymond, Ph.D.'69, has recently co-authored *Beyond Cholesterol,* published by St. Martin's Press, New York. The book deals with the problem of determining the underlying mechanism causing arteriosclerosis; it presents a vigorous argument against the primacy of cholesterol as a causal agent, suggesting that the prevailing "risk factor" approach has not been therapeutically effective. . . . **Raymond Kaempfter,** Ph.D.'65, reports that since 1978 he has been a professor of molecular biology at the Hebrew University, Hadassah Medical School, Jerusalem, Israel.

VIII
Physics

Victor F. Weisskopf, Institute Professor Emeritus and Professor of Physics Emeritus at M.I.T., has been selected as co-recipient of the 1981 Wolf Prize in Physics, awarded by the Wolf Foundation in Israel, in recognition of "his outstanding contributions to theoretical physics, especially in the development and application of the quantum theory of physics." He shares the $100,00 prize with Professor Freeman Dyson of Princeton. . . . **Otto Morningstar,** Ph.D.'39, has been elected chairman of Data Packaging Corp., Cambridge, Mass., a manufacturer of plastic components for computer peripheral equipment. . . . **A. Julian,** S.M.'53, writes that he recently retired for the second time

from General Electric Co. and is consulting from the Myrtle Beach area. . . . **Joseph E. Robertshaw,** Ph.D.'58, has recently co-authored *Home Energy Management,* published by Petrocelli Books, Inc.

Jean-Pierre Letouzey, S.M.'73, is presently chief of the Advanced Systems Department (weapons systems) at Aerospatiale-Helicopter, Marignane, France. . . . **John D. Mallett,** S.M.'46, writes, "After 23 years with Rand Corp. and one year at Technical Services Corp., five of us formed a company called Adaptive Sensors, Inc., 1½ years ago. This, tennis, and sailing keeps me busy." . . . **Edward C. Reifenstein III,** Ph.D.'68, is currently vice-president, management information systems for Computer Management Dynamics, Nashua, N.H. . . . **Robert N. Noyce,** Ph.D.'53, vice chairman of Intel Corp., has been elected a director of Rolm Corp., Santa Clara, Calif., a maker of computer and commmunications equipment. . . . **Alexander Julian,** S.M.'53, has retired ("for the second time") from General Electric Co. and is now a resident of Myrtle Beach, S.C.

Norman E. Moore, Ph.D.'41, retired state director of economic aid for southeastern Massachusetts who had been assistant attorney general of Massachusetts and chief secretary to former state attorney general George Fingold, passed away on October 25, 1981. . . . **Michael A. Machtey,** Ph.D.'69, a memeber of the Department of Computer Science at Purdue University, West Lafayette, Ind., passed away in September 1979; no details are available.

X

Chemical Engineering

Peter M. Hirsh, S.M.'79, writes that he is presently a chemical engineer in the process engineering division of the General Atomic Co., San Diego, Calif., doing research and development on a nuclear fuel reprocessing off-gas treatment system for D.O.E. . . . **Pieter Stroeve,** Sc.D.'73, has left his former post as associate professor at the State University of New York at Buffalo and has accepted a position as associate professor of chemical engineering at the University of California at Davis . . . **Robert H. Cohen,** S.M.'39, reports that is doing consulting activities in the food industry and in technology transfer to developing nations have kept his "retirement" very busy. He and his wife enjoy Marco Island, Fla., very much.

Ernest O. Ohsol, Sc.D.'39, writes, "I am working in Houston, Tex. on an educational project for the Shell Petroleum Development Co. of Nigeria, training native Nigerians in the operation of oil and gas producing stations. Spent some time at Warri River, Nigeria." . . . **Robert E. Lueders,** S.M.'55, reports, "I'm active in local peace work advocating nonviolence, using our technical capabilities only for peace generating purposes, severe limitations of fission nuclear power until we can learn to use it in a totally safe and non-threatening context (perhaps never), and total abolition of nuclear weapons and warfare as a method of resolving human conflict." . . . **Hugo Tribin,** S.M.'63, is president and owner of Aservin Ltd., engineering consultants with the petroleum industry with major emphasis on natural gas.

Howard S. Bryant, Sc.D.'52, writes, "Duties as vice president, engineering for Witco Chemical Corp. have been expanded to include responsibility for safety, industrial hygiene, and environmental affairs. The new office for these functions is located in Woodcliff Lake, N.J." . . . **George R. Jasny,** S.M.'52, vice president of Union Carbide's Nuclear Division, Oak Ridge, Tenn., has been named a fellow of the American Institute of Chemical Engineers, for his "contributions to energy technology, particularly in the management of nuclear energy facilities." . . . **William S. Grow,** S.M.'68, is assistant executive officer of the California Air Resources Board. . . . **Jean-Louis L. Roux-Boisson,** S.M.'78, reports that he has been drafted into the French Army and promises "more information by the end of the year (hope so)." . . . **Ralph Dockendorff,** Sc.D.'36, writes, "I retired from Exxon in 1977, after 41 years of service. I am now consultant to several Exxon divisions and other clients in the fields of process design and safety/fire protection design in particular. I have participated with the API subcommittee on pressure refining systems since 1970, and as a member for Exxon and as an individual." . . . **Warren E. Stewart,** Sc.D.'51, reports that he has received the Benjamin Smith Reynolds Award for excellence in teaching of future engineers from the College of Engineering, University of Wisconsin, Madison (1981); and the Alpha Chi Sigma Award for chemical engineering research, awarded by the American Institute of Chemical Engineers (1981).

Roy N. Levitch, Sc.D.'66, writes, "After 15 years in Houston with Shell Oil, I transferred to Phoenix as business planning manager of the newly formed partnership between the solar photovoltaic subsidiaries of Shell Oil and Motorola. I am moving with my wife (an ex-Techretary) Janine and three sons, Mark (11) and twins Brian and Barry (8)." . . . **Albert S. Humphrey,** S.M.'49, has been on the board of nine companies and has consulted with 46 companies in the U.K., U.S.A., Mexico, France, Switzerland, Germany, Norway, and Denmark. . . . **Charles E. Hummel,** S.M.'49, former president of Barrington (R.I.) College who is a specialist in history and philosophy of science as they relate to religion, delivered the Stanley Distinguished Christian Scholar Lectures on October 8-9, 1981, at Bates College.His subject: "Biblical Revelation and Modern Science." Dr. Hummel currently serves as director of faculty ministries with the Inter-Varsity Christian Fellowship.

Quintin P. Peniston, S.M.'33, retired research chemist at the Food, Chemical and Research Laboratories, Seattle, Wash., and at the Kypro Co., Bellevue, Wash., passed away on September 23, 1981.

XI

Urban Studies and Planning

Wayne Moody, M.C.P.'67, is curently planning director for the City of Tucson, Ariz.; lecturer in architecture and public policy, planning, and administration at the University of Arizona; president of the Arizona chapter of the American Planning Association; trustee of the Arizona-Sonora Desert Museum; and on the Board of Directors of the Planning Association of Arizona. . . . **Melvin F. Levine,** M.C.P.'56, reports that he formed the firm of Melvin F. Levine & Associates, Inc., in the fall of 1981 to provide consulting services in creating urban development opportunities and organizing urban development management districts. He had been with the Rouse Co., developers of Faneuil Hall Marketplace, and the American City Corp., consulting subsidiary of the Rouse Co., from 1970 to 1981.

XIII

Ocean Engineering

The third annual reunion of Courses XIII, XIII-A, XIII-B, XIII-C, and XIII-W (all associated with the Department of Ocean Engineering) was held at the Warwick Hotel, Thursday, November 19, 1981, during the annual meeting of the Society of Naval Architects and Marine Engineers, which is attended by many of the department's alumni/alumae.

About 85 persons attended the cocktail party and buffet dinner. The list, taken from the register at the door, is as follows: **Leonid Afanasieff,** '68; **John Arrison,** '78; **George Blossom,** '79; **John O. Bowden,** '57; **Laurence R. Breves,** '42; **Russell W. "Russ" Brown,** '42; **Clarence R. "Russ" Bryan,** '52; **Carleton F. "Carl" Bryant,** '67; **Richard L. Cannaday,** '45; **Chryssostomos "Chryss" Chryssotomidis,** '70; **Fen-Dow Chu,** '66; **E. Judson Cole,** '44; **Donald E. Courtsal,** '56; **Richard F. Cross III,** '44; **John D. Crowley,** '57; **Bruce G. Curry,** '52; **Charles R. Cushing,** '60; **Pinhas T. Diamont,** '69; **Thomas R. Dyer,** '67; **Dennett K. "Deke" Ela,** '44; **Bennett Fisher,** '34; **William C. Freeman,** '42; **Theodore E. "Ted" Gerber,** '46; **Julio Gianotti,** '71; **Audrey B. Greenhill,** '79; **Leslie A. "Les" Harlander,** '55; **Edward T. "Ed" Hill,** '48; **L.V. "Mike" Honsinger,** '32; **Owen F. Hughes,** '61; **Stuart C. Jones,** '46; **Keatinge Keays,** '55; **Dorothy (nee Klepascz) Kevesian,** '79; **Jonathan D. Kaskin,** '79; **Gilbert L. Kraine,** '58; **Reuven Leopold,** '61; **Donald Liu,** '66; **Douglas C. "Doug" MacMillan,** '34; **Henry S. "Hank" Marcus,** '67; **James H. "Jim" Mays,** '79; **Carl R. Meurk,** '42; **Mark C. Oakes,** '73; **J. Randolph "Randy" Pauling,** '52; **Eugene K. Pentimonti,** '67; **Pramud Rawat,** '61; **Donald E. Ridley,** (SE'75); **Richard H. "Dick" Roberts,** '55; **Hubert E. Russell,** '59; **Myron R. Sawyer,** '59; **Robert S. Schoenberger,** '82; **Bruce C. Skinner,** '65; **Nobert E. Smyth,** '46; **Gerald C. Swensson,** '44; **Vincent C.S. Wang,** '81; **Charles C.L. Weng,** '46; **Roderick M. "Rod" White,** '56; **John F. Wing,** '55; **Allen Zang,** '52.

For those that may be omitted from this list but who did attend, our apologies. With so many attending the affair, the register is our crutch.

The honored alumnus was Rear Admiral **Leroy V. "Mike" Honsinger,** S.M.'32, U.S.N. (ret.). "Mike has a long list of accomplishments including deputy commander of the Bureau of Ships, commander of Long Beach and Mare Island Naval Shipyards, vice president of shipbuilding for Todd Shipyards, and president of both ASNE and SNAME." "Mike" shared some of his experiences with the group and was presented with a plaque as a memento of the occasion.

"Chryss" Chryssostomidis, '70, acting head of the department, described some of the highlights of the past year from his perspective. **"Bill" Freeman,** '42, served as master of ceremonies and announced the fourth annual Course XIII reunion which will be held at the Warwick Hotel, New York City on Thursday evening, November 18, 1982.

In addition, the department received letters from **C. Ellis Ellicott, Jr.,** '15; **Morris Guralnick,** '33; **Ray Keyes,** '40; and **Daniel D. Strohmeier,** '34, all of whom could not attend but sent their best wishes.

Ray Keyes writes "I have been out of the marine game and in the nuclear game. About the time you will be meeting in New York, some of my design reactor core test assemblies should be close to undergoing an irradiation at full power to determine the flux map of the core. . . . It is over 25 years since I did work with ships. I inclined a Coast Guard cutter in San Francisco about 1958 and built some kayaks in 1968. . . . I remember Bill Baker when he worked for Bethlehem Steel in San Francisco years ago and I am not as avid a searcher into the history of boats, but I have become interested in the West Coast Indian boats. I recently visited La Push on the Washington coast to see the work of an Indian maker of dug-out boats. He turned out not to be home, but I looked over the boats lying around his yard. He was finishing a 15-foot-long dugout made by hollowing out a cedar log. . . . I saw **Al Thewlis,** '40, in San Diego about three years ago. By some shenanigans he was appointed cat boat commissioner of California. The certificate of his office makes a very impressive display. Al holds a unique office; what other Course XIII man can claim as much?" . . . Daniel D. Strohmeier, '34, reports that he was unable to attend the reunion because he was cruising in Turkish/Greek waters.

Walter S. Szczypinski, S.M.'66, reports that he is Aegis cruiser acquisition manager, Naval Sea Systems Command. . . . **Hubert E. Russell,** '56, has been elected president and chief executive officer of Morris Guralnick Associates, Inc., San Francisco, Calif. . . . Rear Admiral **Harold L. Young,** S.M.'60, U.S.N., has been assigned to oversee submarine construction at Electric Boat, Groton, Conn.; news accounts describe him as "a troubleshooter in submarine construction." Prior to this appointment, he was commander of the Portsmouth Naval Shipyard in New Hampshire. . . . **Robert I. Price,** '53, U.S.C.G. (ret.) has been appointed senior vice-president and a member of the board of directors of J.J. Henry Co., Inc., New York City, a naval architectural firm. Retired after 36 years in the Coast Guard, he will manage the

firm's New York office.

Robert A. Ortmann, S.M.'76, reports that he presented a paper, "Ship Repair Using Multi-Ship Cost-type Contracting" at the Innovations for the 1980s Shipbuilding and Repair Symposium in Seattle, Wash., on September 18, 1981. . . . **Jan Olaf Williams,** Sc.D.'75, reports that he left his post as head of the Norwegian Petroleum Industry Development Co. and joined Volvo Energy AB on November 1, 1980. . . . **Daniel S. Katavola,** S.M.'75, writes, "I am presently working as an engineer for Han-Padron Associates, a small engineering consulting firm in New York City. The firm specializes in the planning, design, and project management of marine terminals, single point moorings, offshore structures, submarine pipelines, and bulk storage facilities."

Captain **Edward A. Eve, Jr.,** S.M.'41, U.S.C.G., (ret.) passed away after a long illness on October 28, 1981, as reported by his wife, Elizabeth. He served as maintenance officer at the Coast Guard Academy, New London, Conn., from 1953-57, and was retired from service from service in July 1961. From 1964-67, he taught science and industrial arts at Kelly Junior High School, Norwich, Conn. . . . Captain **Wallace H. Garrett, Jr.,** S.M.'46, U.S.N. (ret.) died on September 19, 1981. He was a 30-year veteran of the Navy, and during his career he received a Presidential Citation in 1943—while a gunnery officer in the Pacific—and the Legion of Merit Award in 1968. Following retirement, he served as vice president of the Advanced Technology Corp., McLean, Va.—Keatinge Keays, administrative officer and lecturer, Department of Ocean Engineering, Room 5-228A, Cambridge, MA 02139

XIV
Economics

James G. Kargua, S.M.'76, is deputy minister of finances in the government of the Republic of Kenya, Nairobi. . . . **Nancy Arnone Bord,** Ph.D.'65, has been named dean of the School of Business and Public Administration at Long Island University's Brooklyn Center, the first woman to hold the position. Dr. Bord most recently headed her own firm specializing in the energy industries and earlier served on the professional staffs of Cresap, McCormick and Paget, Inc., New York, and Theodore Barry and Associates; and the Pacific Light and Power Co., Los Angeles. . . . **George W. Shuster,** S.M.'69, has been promoted from vice president and general counsel to group vice-president of Cranston Print Works Co., Webster, Mass. Earlier he was a partner in the legal firm of Edwards and Angell. . . . **Katsuhito Iwai,** PH.D.'72, is presently senior research associate in economics at the Cowles Foundation for Research at Yale University, New Haven, Conn. He is author of a new Yale University Press book, *Disequilibrium Economics,* a theoretical analysis of inflation and unemployment. . . . **Lawrence W. Barss,** Ph.D.'61, has been named vice president and chief economist of the New England Council, Inc., Boston, Mass.

XV
Management

Following Professor **Jay W. Forrester**'s keynote address, members of the 1981 System Dynamics Research Conference in Rennsselaerville, N.Y., late last year voted to organize a continuing annual conference series and to establish in connection with it the Jay Wright Forrester Award for outstanding contributions to system dynamics. Professor Forrester's keynote was on "Political Aspects of System Dynamics"; others from M.I.T. attending the conference included Professor **Edward B. Roberts,** '57, **Nathaniel J. Mass,** '72, **Peter M. Senge,** S.M.'72, **John D.W. Morecroft, Joel Rahan,** and **John D. Sterman** and five other members of the System Dynamics Group: **Alan K. Graham, George Richardson, Jack Homer, Mark Paich,** and **Nathan Forrester**.

Karl Miller, S.M.'63, writes, "With the publication of the current edition of Marquis's Who's Who's in Finance and Industry, I am now listed in a total of three (including *Who's Who in the East* and *Who's Who in the World*)." . . . **John F. Fort,** S.M.'66, has been elected senior vice president of operations at Tyco Laboratories, Inc., Exeter, N.H. He had been vice-president of operations since 1979 and was president of the Tyco subsidiary, Simplex Wire and Cable Co. having been with Simplex since graduation.

Charles G. Musselman, S.M.'75, reports, "I returned from a fact-finding trip around the world in May. I founded a company, Metanoia, to explore international systems solutions. The next application is Sinai development." . . . **F. Hudnall Christopher,** S.M.'59, has been promoted to senior vice president of manufacturing of R.J. Reynolds Industries, Inc., Winston-Salem, N.C. . . . **Donald L. Ravey,** S.M.'61, reports that he has had Apple computer programming articles published recently in several home computer magazines.

Maria-Olivia M. Cenizal, S.M.'79, writes, "I am currently treasurer for two companies, Dynatech, Inc., and Chemark Electric Motors, Inc. Both are wholly-owned subsidiaries of Dynetic, Inc., which is an assembly house for integrated circuits. Dynatech, Inc., manufacturers semi-automated equipment for semiconductor assembly. It is located at the Food Terminal Complex (Celery Road) in Taguig, Manila, Philippines. Chemark manufactures fractional electric motors also in the Philippines. Both companies are export oriented."

Sloan Fellows

Charles E. Craig, S.M.'72, has been promoted to the newly created position of general manager, international operations, of the Timken Co., Canton, Ohio. Prior to this position he was president of Candian Timken, Ltd., St. Thomas, Ontario, Canada. . . . **Nathaniel S. Howe,** S.M.'62, has been elected senior vice-president of Litton Industries and named group executive of the company's Tool Systems Group, New Britain, Conn.; he was formerly corporate vice-president in charge of Litton's machine tool building divisions. . . **Robert J. Schwinghamer,** S.M.'68, director of the Materials and Processes Laboratory at NASA's Marshall Space Flight Center, Hunstville, Ala., has been awarded the NASA Outstanding Leadership Medal for his contributions to the success of the first Space Shuttle mission.

John D. Frazee, S.M.'64, has retired as president and chief operating officer of Finning Tractor and Equipment Corp., Ltd., Vancouver, B.C., Canada. **William Maurice Young,** S.M.'67, chairman and chief executive officer, said a reorganization of the company would be announced late in the year. . . . **Paul A. Heinen,** S.M.'63, has resigned as vice-president, general counsel and secretary of the Chrysler Corp., Highland Park, Mich., to become a vice-president and general counsel at the GATX Corp., a firm specializing in equipment to extract and distribute dry and liquid bulk materials.

Donald V. Fites, S.M.'71, currently president of Caterpillar Brasil, S.A., has been named vice-president for economics, pricing and scheduling, products control and product source planning of the Caterpillar Tractor Co., Peoria, Ill. . . . **Francis A. Wiesner,** S.M.'71, is currently president of Webex, Inc., Neenah, Wis. . . . **Eric W.A. Lange,**

C.E. Craig

D.J. Bauhs

S.M.'62, has joined Packer Engineering Associates as director of automotive engineering, Naperville, Ill. . . . Rudolf Rentsch, S.M.'68, president of the Revere Aluminum Southeast division, was elected chairman of the Revere Technology and Consulting Co., a subsidiary of Revere Copper and Brass, Inc., based in Scottsboro, Ala. . . . **Robert S. Ames,** S.M.'54, has been elected chairman of the Board of Trustees of the National Security Industrial Association.

Senior Executives

Charles E. Verkler, '64, retired on January 1, 1981, as vice-president for purchasing quality and traffic of the Caterpillar Tractor Co., Peoria, Ill.

XVI

Aeronautics and Astronautics

Carl Alexoff, S.M.'56, writes, "In March 1981 I joined Webcraft Games, Inc., a subsidiary of Beatrice Foods Co., as president and chief executive officer. Webcraft is one of the world's largest direct response printing specialists and is headquartered in No. Brunswick, N.J." . . . **Robert L. Townsend,** S.M.'43, retired in 1972 as commander, Naval Air Force Atlantic, with the rank of vice admiral. In 1976 he retired once more from the board chairmanship of Gruman International and is now a consultant.

XVII

Political Science

Professor **Lincoln P. Bloomfield,** in the department at M.I.T. has recently written *The Foreign Policy Process: A Modern Primer,* published by Prentice-Hall, Inc. The idea is to explain in layman's language how foreign policy, particularly U.S. foreign policy, is made; it includes a complete "do-it-yourself" kit for political games. . . . Professor **Michael Lipsky,** in the department at M.I.T., has been awarded major prizes by two social science organizations for his book, *Street Level Bureaucracy: Dilemmas of the Individual in Public Services,* published by Russell Sage (1980):

☐ He was co-winnner of the American Political Science Association's Gladys M. Kammerer Award for the best publication by a political scientist on national policy published in 1980.

☐ He received the prestigious C. Wright Mills Award of the Society for the Study of Social Problems, for a book that best exemplifies social science scholarship in the tradition of sociologist C. Wright Mills.

XVIII

Mathematics

Colin C. Graham, Ph.D.'68, has been promoted to full professor of mathematics at Northeastern University, Boston, Mass.

XIX

Meteorology

Robert M. White, Sc.D.'49, president of the University Corporation for Atmospheric Research, Boulder, Colo., was the recipient of the 25th IMO (International Meteorological Organization) Prize, given for "outstanding contributions to the development of meteorology, leadership in atmospheric sciences, and collaboration in international meteorology."

John R. Seesholtz, Ph.D.'68, reports that he is technical planner for the Chief of Naval Operations Long Range Planning Group, Washington, D.C. . . . **Clifford A. Spohn,** Sc.D.'48, writes, "I retired on January 10, 1981, from the position of deputy director, National Environmental Satellite Service, National Oceanic and Atmospheric Administration, Department of Commerce. I completed 40 years of federal service, 15 with DOC and 25 with the USAF."

XXII

Nuclear Engineering

Trond Bjornard, Ph.D.'77, writes, "I live with my family of four in Lingen, West Germany, where I am responsible for nuclear fuel element design and production processes as Exxon Nuclear Company's engineering representative at its European fuel fabrication plant. Exxon Nuclear's principal plant is in Richland, Wash., which I left in 1980 on a two-year European assignment." . . . **Brian G. Schultz,** S.M.'66, is presently project manager for Stone & Webster Engineering Corp. for the River Bend Nuclear Power Station, San Francisco, Calif. He has successfully directed construction for two years under the Nuclear Power Construction Stabilization Agreement with "no-strike, no lookout" provisions. The plant is 40 percent complete.

Mark H. Magnussen, S.M.'67, is presently vice-president of the Facilities Engineering and Maintenance Corp., Woodbridge, Va. . . . **Jean-Paul Raoul,** S.M.'70, writes, "I have founded a Paris-based consulting engineering firm called Brennus, and I am looking for a partner in the U.S. to sell maintenance services and tools to nuclear utilities." . . . **David J. Bauhs,** Nuc.E.'67, has been named general manager of marketing operations for Westinghouse Electric Corp.'s elevator business unit, Pittsburgh, Penn. Mr. Banks has previously been general manager of Westinghouse's specialty metals division and of the company's uranium resources.

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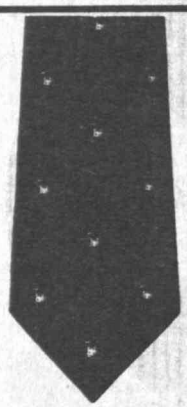

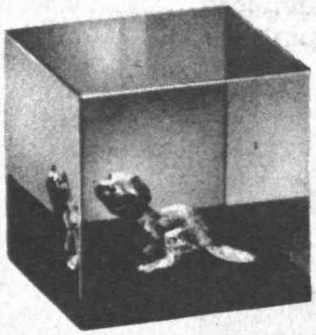

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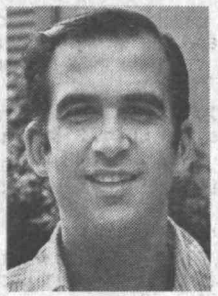


Allan J. Gottlieb, '67, is associate research professor of mathematical sciences at the Courant Institute of Mathematical Sciences of New York University; he studied mathematics at M.I.T. and Brandeis. Send problems, solutions, and comments to him at the Courant Institute, New York University, 251 Mercer St., New York, N.Y. 10012.

Let me begin by reviewing the sizes of the various problem backlogs. My cup of regular problems runneth over (more than a two-year supply); I have about a half-year supply of "quickies" and bridge problems; and a year's worth of chess puzzles.

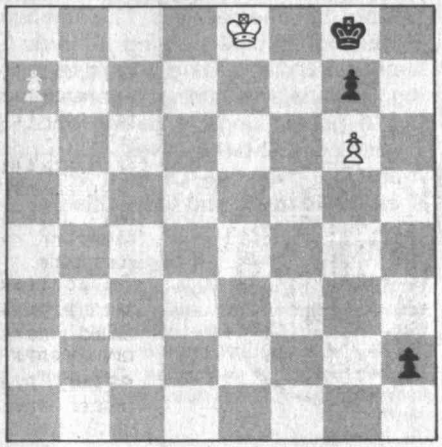
Emmet Duffy comments that about three years ago I indicated that an anthology of problems was being considered. Mr. Duffy then remarks, "What happened? Get going and pay off the mortgage!" What happened was that a reader had at first expressed interest in compiling a collection from Puzzle Corner and then changed his mind. As I have said before, the halls of New York University are not filled with publishers waiting their turns to bid on such an anthology.

Mr. Duffy also expressed an interest in Walter Penny's solution to the perfect squares problem **1981 JAN 2**. If Mr. Penny will supply his method of solution, I will be glad to forward it to all interested parties.

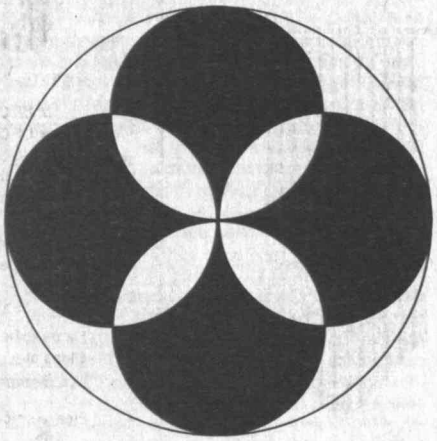
Problems

FEB 1 Winslow Hartford enjoyed the following problem that appeared in *Scientific American* during Martin Gardner's tenure: On an island there are only two trees, A and B, and the remains of a gallows. According to an old map, treasure may be found by following these directions: start at the gallows, pace to A, turn 90° to the left, pace an equal distance, and drive a stake. Return to the gallows, pace to B, turn 90° to the right, pace an equal distance, and drive another stake. Treasure is buried at a point half-way between the two stakes. A treasure hunter, coming to the island, found the two trees, but all vestages of the gallows were gone. None the less, he found the treasure. How did he do it?

FEB 2 Stuart Schulman offers a chess problem in the classic format: White to move and win.



FEB 3 John Prussing's chimpanzee is trained to throw darts at the patterned dartboard below. He can hit the dartboard with one out of every two throws, on the average. What is the probability that on a given throw the dart will hit the shaded region?



FEB 4 John Rule wants you to locate the point P in the plane of a given triangle ABC such that triangles PAB, PBC, and PCA have equal perimeters.

FEB 5 Jerome Taylor thinks our orbital space flights would be more interesting if done just above the surface of the earth. He writes, "What can be said about the time periods of surface orbits of spheres of the same density but of different sizes?"

Speed Department

FEB SD1 Emmet Duffy has only a compass and pencil and needs to draw a

circle and mark off a 90-degree arc. How can he do it?

FEB SD2 Here's one from Art Delagrange that should help me decide on presents for my wife Alice (it is late November as this is written):
In the traditional Christmas carol, the young lady receives on the first day a partridge in a pear tree; on the second day two turtle doves and a partridge in a pear tree; and so forth until on the twelfth day she receives 12 drummers drumming, 11 pipers piping, 10 lords a-leaping, 9 ladies waiting, 8 maids a-milking, 7 swans a-swimming, 6 geese a-laying, 5 golden rings, 4 calling birds, 3 French hens, 2 turtle doves, and a partridge in a pear tree. Of what items did she receive most, and of what least?

Solutions

OCT 1 With the hands shown, East opens with a weak two-diamond bid (usually six cards, sometimes only five). South's final contract is six hearts. The opening lead: ♦2. What line of play gives South the best chance of making this slam, given the knowledge that West has three trumps?

North:
♠ J 10 5 2
♥ 8 6 2
♦ 7 6 5 4
♣ K J

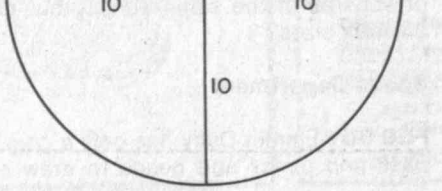
South:
♠ A K
♥ A K Q 5 4 3
♦ A 8 3
♣ A 9

Since East has most of the outstanding diamonds, West has more than a 25-percent chance of having ♠Q and ♣Q. In this case, Rev. Joseph Hahn's solution works: Play ♦A, draw trumps in three rounds, lead ♠A and ♠K, lead ♣9 and finesse the ♣J. Next lead the ♠J, discarding the ♣A. West will have to lead either a spade to the ♠10 or a club to the ♣K; in either case the two little diamonds are parked on these two black cards.

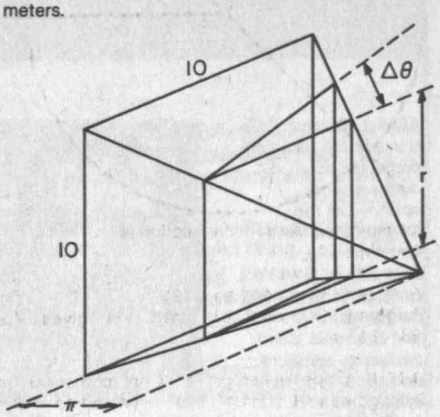
Also solved by Barbara Magid, John Rutherford, John Stiehler, Allen Zaklad, Winslow Hartford, Linda Hicks, Mark Oshin, George Holderness, Matthew Fountain, Richard Hess, and the proposer, Doug Van Patter.

OCT 2 A cow is tethered to a circular silo in such a manner that the distance from the cow's mouth to the fixed tie-point is exactly 10 meters. If the circumference of the silo is exactly 20 meters, how much grazing area does the cow have? (A calculus solution was requested.)

The proposor solved this by treating the silo as an n-gon and taking the limit as n approaches infinity (not quite calculus but in the same spirit). Emmet Duffy's solution reprinted below converts the area of an involute to the volume of a pyramid for which non-calculus solutions are known. Mr. Duffy writes:



The grazing area shown in the figure is a semicircle with radius 10 meters and two involutes. As the rope winds around the silo, the radius varies linearly from 10 to 0 as the angle varies from 0 to π. At a radius r, the area of an elementary sector is $r^2\Delta\theta/2$. The area of the involute is the summation of $r^2\Delta\theta/2$, but the summation of $r^2\Delta\theta$ for the involute is a pyramid with a square base of side 10 in meters and a height of π. Volume is $100\pi/3$. Then the summation of $r^2\Delta\theta/2$ is $100\pi/6$, which is the area of the involute. The total area is then
$2 \times 100\pi/6 + 100\pi/2 = 250\pi/3 = 261.9$ square meters.



Also solved by Richard Hess, Winthrop Leeds, Matthew Fountain, Norman Wickstrand, Harry Zaremba, and Mary Fenocketti.

OCT 3 Find an integer having the property that moving the rightmost digit to the leftmost slot yields a number exactly nine times the original number.

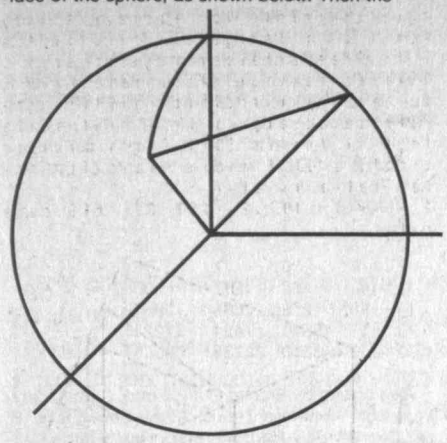
John Woolston and Edwin McMillan generalized the problem, and the following solution is from Harry Zaremba:
Let N be the required integer which in separate digit form is
$N = 10^n a_n + 10^{n-1}a_{n-1} + 10^{n-2}a_{n-2} + \ldots + 10^2 a_2 + 10a_1 + a_0$.
By moving a_0 to the extreme left position, the new number M will be
$M = 10^n a_0 + 10^{n-1}a_n + 10^{n-2}a_{n-1} + \ldots + 10^2 a_3 + 10a_2 + a_1$.
From the condition of the problem,
$M = 9N$. (1)
If we substitute the digital form of the numbers into the latter relation and rearrange the terms so that only the a_0 terms remain on the right, we get
$10^{n-1}a_n + 10^{n-2}a_{n-1} + \ldots + 10a_2 + a_1 = (10^n - 9)/89 \cdot a_0$. (2)
The fractional factor on the right of the equation will be an integer when $n = 43$, and the relation (1) will be satisfied when $a_0 = 9$. Therefore, the integer expressed by equation (2) is a 43-digit number equal to 1,011,235,...,022,471, where digits $a_{43} = a_1 = 1$. Attaching $a_0 = 9$ to the right of the above number, the required value of N is a 44-digit number:
10,112,359,550,561,797,752,808,988,764,044,943,820,224,719.

Also solved by Matthew Fountain, Avi Ornstein, Harry Zaremba, Emmet Duffy, John Bobbitt, Bruce Garetz, Susan Henrichs, Norman Spencer, Mark Oshin, John Rule, Donald Savage, Eric Willsky, Winslow Hartford, R. Mullikin, Winthrop Leeds, V. Caravito, Richard Hess, Mary Fenocketti, and the proposor, Bill Bezdecheck.

OCT 4 In the Ballantine Beer logo, in which three circles of equal radius are placed so that the center of each circle lies on the boundary of the other two, the area of the region of intersection is $r^2\pi - \sqrt{3})/2$. Now consider the three-dimensional analogy: find the volume of the region of intersection of four spheres of radius r, each of which has its center on the surfaces of the other three.

Only Richard Hess, Emmet Duffy, and Greb Huber submitted solutions to this problem. Hess' solution is as follows:
The centers of the spheres lie on the vertices of a tetrahedron of side r. Let V_1 be the volume of the tetrahedron and V_2 be the volume subtended by the

solid angle of the tetrahedron vertex and the surface of the sphere, as shown below. Then the



volume of the desired intersection is

$V = 4V_2 - 3V_1$ (1)

$V_1 = (r^3 \cdot 2^{1/2})/12$ (2)

$V_2 = (4r^3/3) \arctan(\tan\pi/12)^{1.5}$ (3)

Plugging (3) and (2) into (1) gives $V \simeq .38149407r^3$.

OCT 5 A positive-integer solution to the pair of Pythagorean relations $A^2 + B^2 = C^2$ and $(A+3)^2 + (B+3)^2 = (C+4)^2$ is the trivial triple (A,B,C) = (0,1,1). Find two other positive-integer solutions, and determine if there are a finite or infinite number of such solutions.

The following solution is from Charles Sutton:

Given the equations

$A^2 + B^2 = C^2$ (1)

$(A+3)^2 + (B+3)^2 = (C+4)^2$ (2)

It is well-known that solutions of (1) are given by

$A = 2mn,\ B = m^2 - n^2,\ C = m^2 + n^2$ (3)

where m and n are integers. Substituting these equations in (2) and simplifying gives $m^2 - 6mn + 7n^2 - 1 = 0$, which when solved for m yields

$m = 3n \pm \sqrt{2n^2 + 1}$ (4)

Clearly $2n^2 + 1$ must be a perfect square. n = 0 gives the trivial solution (A,B,C) = (0,1,1), while n = 2 gives (12,5,13) and (36,77,85). A TI 58 calculator was programmed to find values of n for which $2n^2 + 1$ is a perfect square, with the result

n = 0, 2, 12, 70, 408, 2378, 13860, ---- (5)

This sequence is interesting, since the ratio of successive terms appears to approach a limit rapidly and suggests the well-known Fibonacci sequence, which behaves similarly. Does the sequence (5) likewise satisfy a second-order recurrence relation? Assuming $u_{k+2} = Pu_{k+1} + Qu_k$ and substituting the first four values from the sequence gives 12 = 2P, 70 = 12P + 2Q, from which P = 6, Q = -1, so

$u_{k+2} = 6u_{k+1} - u_k$ (6)

This is also found to be satisfied by the other members of the sequence and so apparently provides an easy method of continuing the sequence.

To get an explicit formula for any term of the sequence, assume $u_k = r^k$ and substitute in (6). Dividing out r^k gives $r^2 = 6r - 1$, from which $r = 3 \pm 2\sqrt{2}$. Since (5) is a linear difference equation, the general solution is

$u_k = C_1(3 + 2\sqrt{2})^k + C_2(3 - 2\sqrt{2})^k$

Substituting k = 0, $u_0 = 0$ and then k = 1, $u_1 = 2$ gives $0 = C_1 + C_2$ and $2 = C_1(3 + 2\sqrt{2}) + C_2(3 - 2\sqrt{2})$, from which $C_1 = 1/2\sqrt{2}$ and $C_2 = -1/2\sqrt{2}$. Hence

$$u_k = \frac{1}{2\sqrt{2}} \left[(3 + 2\sqrt{2})^k - (3 - 2\sqrt{2})^k \right] \quad (7)$$

To prove that this formula gives *all* terms of the sequence (5), that is, $u_0 = 0, u_1 = 2, u_2 = 12, \ldots$, we show that $2u_k^2 + 1$ is a perfect square.

$$2u_k^2 + 1 = \frac{1}{4} \left[(3 + 2\sqrt{2})^{2k} - 2 + (3 - 2\sqrt{2})^{2k} \right]$$

$$= \frac{1}{4} \left[(3 + 2\sqrt{2})^{2k} + 2 + (3 - 2\sqrt{2})^{2k} \right]$$

$$= \left[\frac{(3 + 2\sqrt{2})^k + (3 - 2\sqrt{2})^k}{2} \right]^2$$

We can conclude that there exist infinitely many solutions of the simultaneous equations (1) and (2), and that these solutions (A,B,C) can be most easily written down by using (6) to calculate values of $n = u_k$ in the sequence (5), calculating two corresponding values of m from (4), and finally getting A, B and C from (3). A few such values are shown below:

n	*m*	*A*	*B*	*C*
0	−1	0	1	1
0	1	0	1	1
2	3	12	5	13
2	9	36	77	85
12	19	456	217	505
12	53	1272	2665	2953
70	111	15540	7421	17221
70	309	43260	88736	100381

Also solved by Emmet Duffy, Frank Carbin, John Woolston, Winthrop Leeds, Mary Lindenberg, R. Mullikin, Winslow Hartford, Mark Oshin, John Bobbitt, Avi Ornstein, Matthew Fountain, Richard Hess, and the proposer, Harry Zaremba.

Better Late Than Never

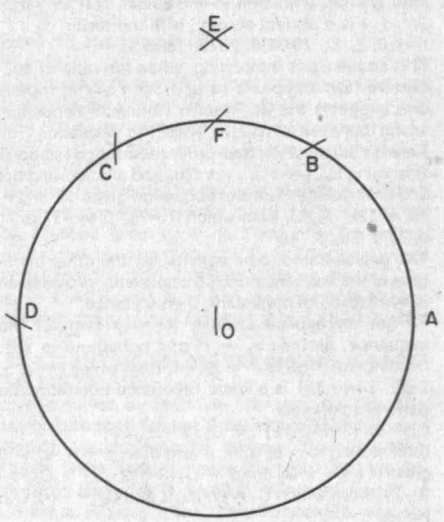
MAY 3 Richard Hess admits that he lost the $26 \cdot 10^{-21}$. As penance he calculated the first 250 digits:

1.29128599706266354040728259059560054149861936827452231731000244513694453876523445555881704112942970898499507092481543054841048741928486419757916355594791369649697415687802079972917794827300902564923055072096663812846701205368574597870300-12778941292882 . . .

A/S 3 J. Meier sent a beautiful solution, which he was inspired to write by his knowledge of Professor Norbert Wiener.

Proposers' Solutions to Speed Problems

FEB SD1 Draw the circle with center at 0. Then at any point on the perimeter mark off B, C, and D with chords AB, BC, and CD equal to the radius of the circle.



With a radius equal to AC and centers at A and D, draw arcs intersecting at E. With radius equal to OE and center at A draw an arc intersecting the circle at F. Arc AF is 90°. Proof: Let R equal the radius. Then $AC = \sqrt{3}R$. By construction, $AE = \sqrt{3}R$. If lines were drawn from 0 to A and E and from A to E, triangle OEA would be a right triangle with base R and hypothenuse $\sqrt{3}R$, making $OE = \sqrt{2}R$. Chord $AF = \sqrt{2}R$, which is the length of a chord of a 90°-arc.

FEB SD2 This is, of course, a binary distribution. She received 42 swans and 42 geese, but only 12 drummers and 12 partridges with accompanying pear trees.

sive enjoyment over the more difficult business of making music oneself: "You can buy [your child] a piano or a violin," a 1910 advertisement from a mass-circulation magazine argues, "but consider that it will be years before a child can play either of them well, and then only if practice has been a daily duty constantly performed. Why should you spend the money for music lessons, and why should the satisfaction of enjoying the best playing of the best compositions be deferred when you can have a Violano-Virtuoso now?" The virtues of passivity were thus early coupled with two other ideals that would remain significant into our own time—the home as entertainment center, and "culture" as an item of consumption.

By the 1930s movies and radio had achieved their preeminence as leisure-time entertainments in America. Purveyors of magazines and newspapers had striven for mass markets since the mid-nineteenth century, but the relative ease of publishing made it possible for numbers of specialized organs to coexist in a diversified market. However, the new electronic mass media had fewer and more costly communication channels, and mounting programs that appealed to the largest number of consumers became essential.

One such strategy for holding attention was to engage the listener in a drama that obliterated his or her concern with the immediate environment. A 1940 advertisement for a radio console, for example, promises that the magic of radio "carries you on thrilling journeys to exciting places—brings colorful people to call who become closer friends than the folks next door." The promise is remarkable—are the folks next door so boring? We are moving here into the contemporary world of the technological media, a world where artifice doesn't simply faithfully reproduce reality: it surpasses reality.

Though the precise degree to which TV influences behavior is open to question, one thing is clear: the packaged dramas of the mass media are usually misleading as guides for our personal lives and political problems. For example, studies reveal that viewers often greatly underestimate the number of blacks, Chinese, Puerto Ricans, and other American minorities, and exaggerate the number of police and criminals, as a result of the skewed demography of TV shows. Such a misperception can affect a viewer's self-image and sense of power.

Similarly, anyone who relies on television news lives in a world in which neighborhood fires follow presidential fanfares every evening. Television's virtue—instantaneous communication—is also its failing. The underlying causes of major events, the long-term trends that one might have some control over, are rarely covered on TV unless they fulfill the dramatic requirements of the evening news. Our widely celebrated "information society" is more accurately a "news society," and what is "news" is far different from what an informed society should know. If it is true that the average viewer takes in six hours of TV a day, then it's little wonder we live in a world where political leaders are elected on the basis of how much air time they can buy and how effective they are as "communicators."

Taking Control

Now we are said to be on the verge of another communications revolution that presumably will democratize and make more flexible the communication process in America. Every week there is a story in the newspapers and national magazines on the growth of cable TV, the interactive systems such as Qube, and the home computer that promises to balance our budgets, manage our households, and all but become our best friend. Control of the media and computers is passing into the hands of the consumer, we are told—the passive mode is giving way to the active.

Televisions, stereos, cameras, and automobiles have long boasted internal mechanisms that can achieve with miniature feedback systems a smooth and virtually automatic operation. But the consumer had to stay interested, so for every internal improvement, designers added a superfluous switch or meter that allowed the user to feel he or she was actually in control. But the new communications media are not merely facades of active control. They genuinely require the user to make significant choices, to participate in the operation of the mechanism, to program or respond to the machine in ways that make the media tools and not simply entertainments. These, at least, are the claims.

And these promises may indeed come true. We are not necessarily limited to watching reruns of "I Love Lucy" and "The Beverly Hillbillies" until the next century. These and other network productions may have served Americans as the currency of common culture, but decentralized video production could give us something else—the expression of regional and local differences, the preservation of vanishing local arts and ethnic cultures, and the exploitation of the video screen as an independent art medium. We are eager to believe that the technology has this potential,

The new technology may change us, but only in ways already set by the structure and values of society.

but we are still under the spell cast by McLuhan, believing that the medium is more important than the message. It is far more probable that the fate of the new communications technology will be like that of its predecessors: the new technology may change us, but it can change us only in ways already set by the structure and values of society.

Promises, Promises

Cable TV offers us a choice of channels far broader than the conventional mix of local and national programming. But the paradox of cable is that its very diversity, with each station appealing to a minority of the viewing population, will reduce the amount of money available to produce individual programs. Hence, cable will probably continue to be an outlet for movies (pornography has become the leading attraction), TV reruns, some (usually low-quality) locally produced programming, and sports.

Another drawback is that cable threatens to further polarize American society by giving to those who are willing or able to pay greater access to information than those who aren't or can't. For a society in which information is increasingly a commodity of practical consequence, this inequity may be worth worrying about.

Or consider the promises of Warner Cable Corp.'s Qube interactive system, whereby the subscriber can register his or her response to the television's queries on everything from how the drama should reach its conclusion to how a political representative should reach a decision. The participation of the consumer, we are told, promises an increase in democracy, a new level of participation in local and national government.

But think of the potentials for misuse. First, if only one segment of society is registering its political voice, the tally will hardly be representative of public opinion, though it may well be taken as such. Second, how a question is framed and how much information is given is crucial. Instant decisions, based on questions controlled by the programmer, offer undreamt-of opportunities for manipulation.

Yet another virtue of the new media, it's argued, is its flexibility in supplying information on which subscribers can base their personal, business, and political decisions. Subscribers can order the categories of news they want to hear and exclude categories they don't, leaving out the "facts" of life that may be sneaking up with unimagined and unwanted effects. The principal asset of this self-created news service—instantaneous communication of the latest information—reinforces the problem with even the best network news—namely, an emphasis on passing events rather than underlying causes.

These new technologies—cable TV, the Qube system, the home information service, the affluent viewer's library of videotapes, and the home computer that allows people to shop at home or conduct business from the living room—all seem to signal a radical shift from the consumer's passive role to a more active, controlling role. But regarded from another angle, the new media simply bring the marketplace to the consumer. And since everything is coming in on a screen, diminishing the need for face-to-face encounters, the consumer's social isolation increases.

A world in which the video screen looms larger and larger is a world in which public gatherings, live entertainment, street life, chance meetings in public spaces—the whole spontaneous fabric of urban life—gradually disappear. The well-furnished American home of the future promises to be a private universe of surrogate experience rather than part of a living community. The driving force behind the utopian promises of the new technology is not a social vision nor a political philosophy promoting justice. Rather, it is based on business and the genius of technology. The real social effects of the new media technology will surface only gradually, and after the fact.

Miles Orvell is associate professor in the American Studies Program at Temple University. He is currently writing a book entitled *The Real Thing: Reproducing American Culture 1850-1940.*

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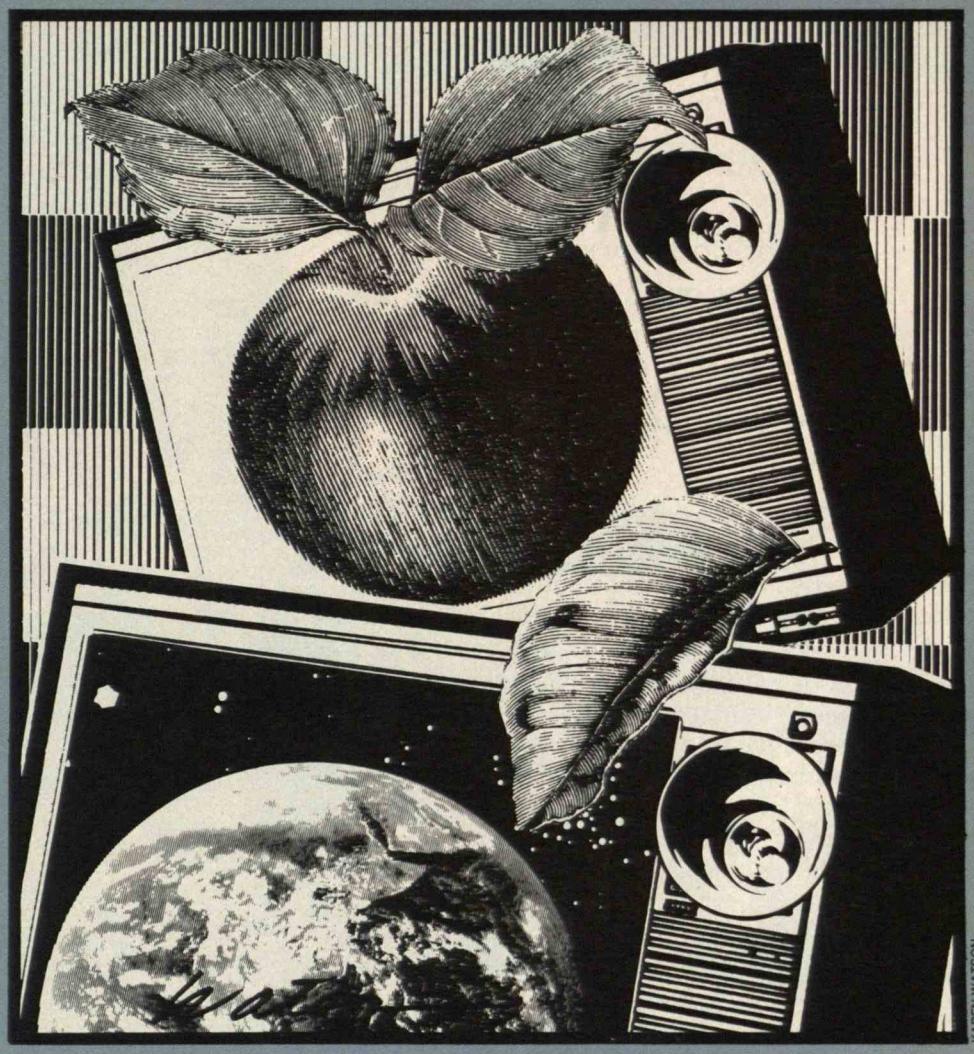
A Is for Apple


KAREN WATSON

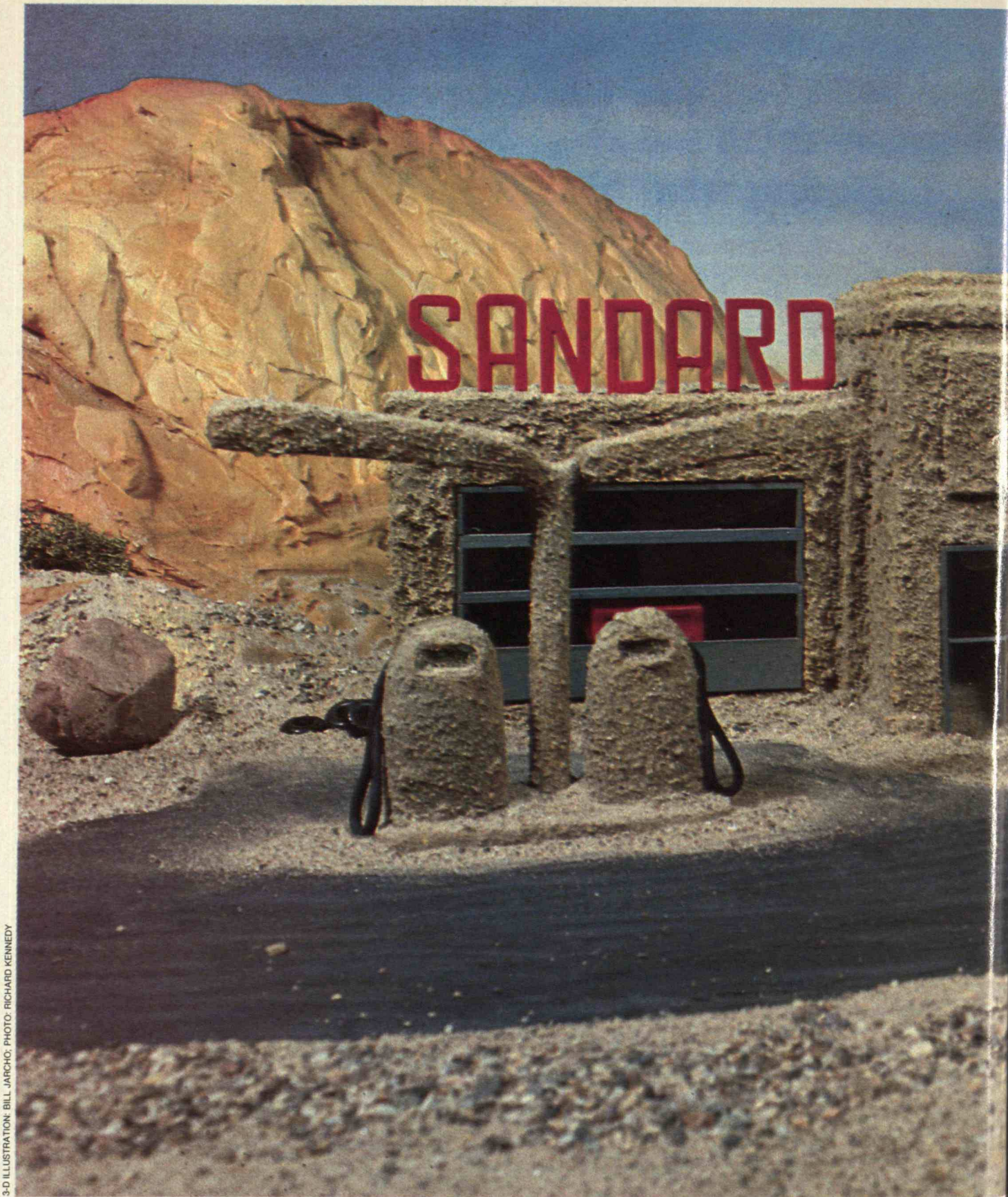
One of the most promising uses of the new communications technology is as a motivational tool in education. It is one thing for students to sit in front of a TV and soak up whatever appears; it is quite another for them to actually produce their own video programs, especially when these may then be sent to other classes in the United States and foreign countries. In fact, the exchange of videotapes between American and foreign students has been going on for several years, having originated with Dr. Alan Soffin at Wissahickon High School in Ambler, Pa.

Dr. Soffin's International Videoexchange Program goes beyond its pen-pal analogue in its potential for teaching language and cultural exchange. Students creating videotapes for transmission are forced to clarify their own conceptions of local customs of architecture, musical expression, and technological artifacts. Hence, they are motivated to research the subject under consideration. If the tape is exchanged with a foreign class, the students—within the limits of their language proficiency—present their subjects in the appropriate language. The procedure works in reverse when the receiving class sends back its own production, which may be done in both its native language and English.

The cost for equipment compatible with French and German systems is under $10,000. Production is possible using facilities costing as little as $2,500, but the visual signals in the various national systems must be made compatible using a computer. The cost of the converter is high ($136,000), but Dr. Soffin hopes to establish an institute, equipped with a converter, that would serve as a clearinghouse for international video education.

The video exchange program takes a medium that has been traditionally used for passive consumption and turns it into an active communication tool. The program has the added potential of demystifying television technology. Knowing what goes into a video production, students may regard the medium not as an inevitable source of "truth" but as a flexible device in which messages are constructed for specific purposes.

Dr. Soffin's program has already prompted exchange visits between high-school students from the United States and Germany. The possibility of using the method at all educational levels—from elementary school to college—makes the video exchange a potentially powerful force in international education. Of course, it is also a tool for learning about regional cultures within the United States.—*M.O.* □



3-D ILLUSTRATION: BILL JARCHO; PHOTO: RICHARD KENNEDY

Making Oil From Sand

by Mohsen Shahinpoor

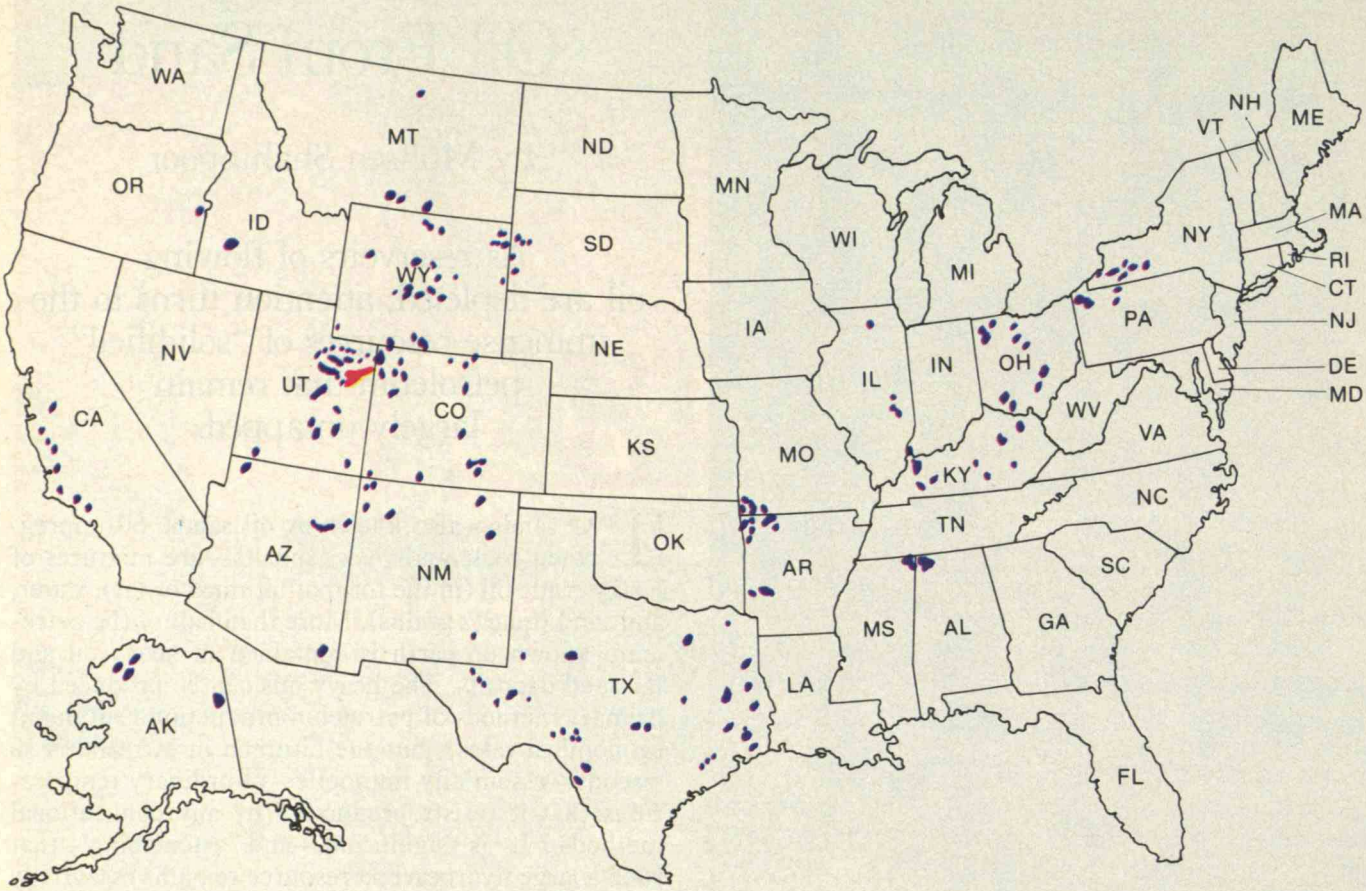
As reservoirs of flowing oil are depleted, attention turns to the immense resources of "solidified" petroleum that remain largely untapped.

TAR sands—also known as oil sands, oil-impregnated rock, and rock asphalts—are mixtures of heavy crude oil (in the form of bitumen or tar), water, and sand (quartz grains). More than half of the petroleum known on earth is contained in heavy oil and tar-sand deposits. The heavy oils can be produced by primary methods of petroleum production (but not at economical rates), but the bitumen in tar sand is so viscous—essentially immobile—at ordinary temperatures that it resists production by any conventional methods. It is significant—and astonishing—that such a large hydrocarbon resource remains essentially untapped despite our growing concern over dwindling petroleum resources.

Oil sands are reported on every continent except Australia and Antarctica; some 550 occurrences are known in 22 states of the United States. The best-known deposits are the giant Athabascan and other resources of northern Alberta in Canada (which contain over 1 trillion barrels), the tar sands of Colombia, and the deposits of the "tar belt" of Venezuela. Though the U.S. tar-sand resources are small (about 50 billion barrels), they nevertheless represent a significant potential when compared with our current annual production of about 4 billion barrels of petroleum and condensate.

About 70 percent of U.S. tar-sand resources are located in Utah, where six deposits containing from 1 to 16 billion barrels each are known. Four of these—Asphalt Ridge, Hill Creek, P.R. Spring, and Sunnyside, all in the Uinta Basin—contain over 10 billion barrels of low-sulfur oil (less than 0.5 percent sulfur by weight), and these are the focus of current interest in developing production from U.S. tar sands. Other significant U.S. deposits are in Texas, Colorado, Wyoming, New Mexico, Oklahoma, California, Mis-

Tar-sand deposits have been identified in 22 of the 50 U.S. states, but most are small. The 50 billion barrels of crude contained in the U.S. tar sands represent ten times our current annual demand for domestic and imported oil. About 70 percent of the total resource is located in what is called the "tar-sand triangle" in the Uinta Basin of Utah, the product of a richly organic lake that covered much of the Rocky Mountain Basin 60 million years ago. The largest and most accessible of these resources is Asphalt Ridge, shown in red on the map.



souri, and Kentucky.

The large deposits in the Uinta Basin of Utah are the most accessible of U.S. tar sands; Asphalt Ridge, a few miles from Vernal, Utah, is the primary resource and the site of the first mining and recovery projects. Tar-sand deposits in P.R. Spring and Hill Creek are in relatively easy but remote terrain, while the richest and most exposed part of the large Sunnyside deposit is in extremely rough country along cliffs 200 or more feet high above narrow canyons.

Commercial utilization of even the most accessible U.S. resources is currently limited to the production of paving materials. The only tar-sand deposits now being commercially produced on a large scale are those of the Athabasca Basin in Alberta, an operation begun about 14 years ago. These deposits cover many square miles, and present estimates are that just over 350 billion barrels of synthetic crude oil will prove to be recoverable from these resources. Of this, some 82 billion barrels are considered economically recoverable by today's surface-mining technology and extraction methods.

The U.S. tar sands originated in a large, richly organic lake that persisted for 20 to 50 million years in the structural depression we now call the Uinta Basin. Lake Uinta was a prolific generator of oil: crude oil in Wyoming and Utah, oil shales in Utah and western Colorado, and tar sands in Utah. It laid down a treasure—trillions of barrels—of fossil energy. This resource is generally low in sulfur content (0.2 to 0.9 percent, with an average of 0.45 percent), in comparison with the usual Environmental Protection Administration standard of less than 1 percent.

Tar sands are generally believed to have been discovered almost a century before conventional oil reservoirs. This is because tar sands are stratified shallow mineral fields that in some places rise to the surface of the earth, where the petroleum remains immobile even when exposed to weathering. Many of Utah's deposits were noted as early as the 1880s, and some were mined for paving beginning in the early 1890s. The surface indication of oil led to the drilling of numerous shallow wells in a futile search for conventional oil between 1900 and 1925, some in the

most rugged and remote areas in the West.

Yet despite these early activities, the exploitation of domestic tar-sand deposits as sources of energy and petrochemicals is constrained by a tangled web of natural and institutional problems. The natural problems are those of the resource itself and of geography, terrain, and water. The institutional problems have to do with environmental and other regulatory constraints and jurisdictional disagreements.

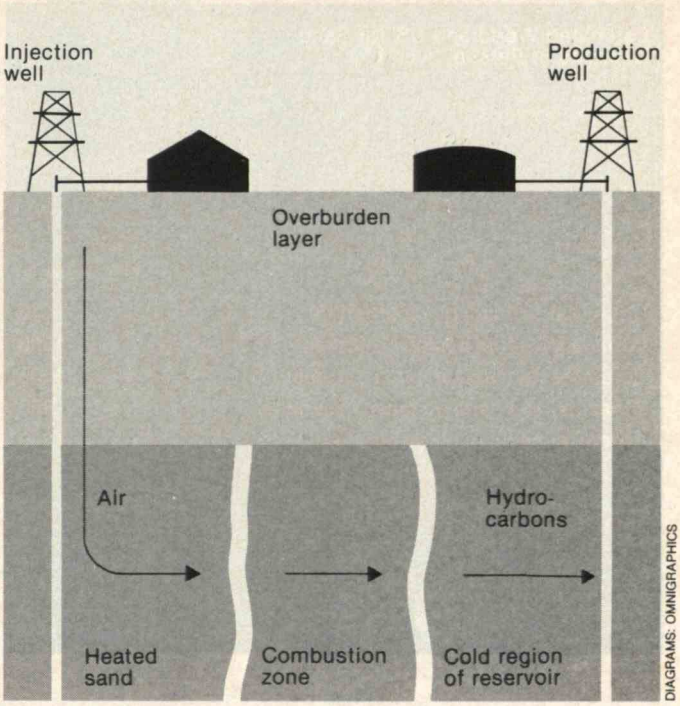
The Athabasca tar sands now in production lie in deposits 30 to 70 meters thick under no more than 25 meters of overburden. The bitumen content varies from 6 to 18 percent by weight, and the areas are large and the terrain in general flat and swampy. The oil recovered is roughly like a heavy crude oil but with much higher molecular weight and viscosity; it is generally composed of about 84 percent carbon, 10 percent hydrogen, 0.5 percent nitrogen, 4.5 percent sulfur, and 1 percent oxygen.

Compared with Canadian tar sands, the Utah tar sands are in smaller deposits with intervening shale beds. The northeastern Utah bitumen is somewhat lower in oil saturation, much lower in sulfur, and twice as high in nitrogen as the Athabasca resource. While Athabasca tar sands contain 3 percent by weight of water and have a significant clay content, Uinta tar sands contain very little water and virtually no clay.

The porosity of Utah tar sands averages about 30 percent. Slightly less than 60 percent of the pore space is filled with oil, and about 4 percent contains water. The remaining 36 percent contains gas at essentially atmospheric pressure; the composition of this gas is not fully known. The fact that Utah is an arid state is reflected in the low water content of the tar sands. Since tar-sand recovery requires a large amount of water (in the Canadian plants, four to six units of water are required for every unit of synthetic crude produced), water supply is one of the constraints on U.S. tar-sand development. Unlike the Athabasca deposits, the Uinta tar-sand formations are seldom horizontal; the tar sand usually dips rapidly beneath the surface from its outcrops, so that surface mining requires removal of increasing volumes of overburden.

Digging Crude Oil with a Dragline

The bitumen in tar sands is highly viscous—immobile for all practical purposes at normal temperatures. Fortunately, the viscosity decreases rapidly with increasing temperatures. Recovery depends on reducing this viscosity by dilution with solvents, dissolution with gases, or heating. An effect resembling viscosity reduction may also be realized by emulsification of the bitumen.



DIAGRAMS: OMNIGRAPHICS

Though the many proposals differ in detail, in situ recovery systems for the bitumen in tar sands are generally based on forcing heated air or solvents into one end of the tar-sand deposit to reduce the viscosity of the bitumen and permit it to flow free of the sand. In one proposal below, air pumped into the tar-sand formation supports combustion of a portion of the bitumen, which provides heat to vaporize the remaining bitumen so that it can be brought up through a production well and condensed into high-quality synthetic crude oil.

At the Canadian mines now in operation, the overburden is typically removed by loaders and trucks and the tar sand itself by dragline, with a conveyer to transport the ore to the processing plant. The overburden materials are used to construct dikes behind which additional overburden and tailings are stored. Hot water forced through the tar sand softens and collects the bitumen, and most of the bitumen is then recovered from the water in a centrifuge. Remaining behind, in addition to the sand itself—which is now larger in volume by about 20 percent than when mined—is a sludge of water, fine sand, and small amounts of bitumen that is collected in large tailings ponds, which present a serious waste-disposal problem. The Athabasca deposit typically contains 0.7 barrel of bitumen per ton of tar sand, from which almost 0.5 barrel of synthetic crude oil can be produced by this method. The maximum yield of bitumen for a highly saturated sand is almost 1 barrel of bitumen per ton of sand.

A similar hot-water extraction process has been developed and successfully tested at the University of Utah on Asphalt Ridge tar sands, but the much lower

Estimated World and US Tar Sand Deposits in Perspective

	(10^9 Barrels)
U.S.A. (tar sand, in place bitumen)	50
Canada (oil sand, in place bitumen)	1000
Columbia (tar sand, in place bitumen)	1000
Venezuela (tar sand, in place bitumen)	800
Africa (tar sand, in place bitumen)	1000
Asia (tar sand, in place bitumen)	500
U.S. annual domestic crude oil and condensate production	4
U.S. annual crude oil imports (estimate)	1
U.S. annual gasoline consumption by automobiles (estimate)	2

water content of Utah tar sands and the scarcity of water in the Uinta Basin may make this method impractical. It is also possible to recover bitumen directly from mined tar sands by heat alone, which serves to vaporize and thermally decompose the bitumen into fractions that can later be condensed into a synthetic crude.

The author has undertaken development of an alternative oil recovery technique in which the mined tar sand is subjected to high-frequency oscillations under high pressure to induce liquefaction of the bitumen, which is then drained out of the sand. However, the oil yield seems insufficient to warrant commercial exploitation. Another alternative presently under study in the author's laboratory combines heating, mechanical agitation, and ultrasonic cavitation to strip the bitumen off the sand grains; the oil is then recovered by water flotation.

A third system—cryogenic recovery—is reported to be a potentially attractive alternative to the hot-water separation process for Athabasca tar sand. It is based on the fact that grinding frozen tar sand yields distinct particles of tar and sand that can be separated by a solvent. In laboratory tests, 84 percent bitumen recovery is claimed for a specially designed fluidized-bed grinder operating at temperatures between -50°C and -130°C.

Tar sand can also be heated with microwaves to produce what has been called a microwave crude oil. Recent tests show that microwave reactors can extract up to 90 percent of the total bitumen present in tar-sand samples, but many technical problems must be solved before a tar-sand microwave processing plant can be built.

Freeing the Tar without Moving the Sand

Since most of the tar-sand deposits in Utah lie under overburdens too thick for economical open-pit mining, and because water required for processing may be unavailable, in situ recovery of the oil from the Uinta Basin has been given considerable attention. The goal of all in situ systems is to reduce the viscosity of the bitumen while it is in place, either by heating or diluting it, and then to collect the liquefied product.

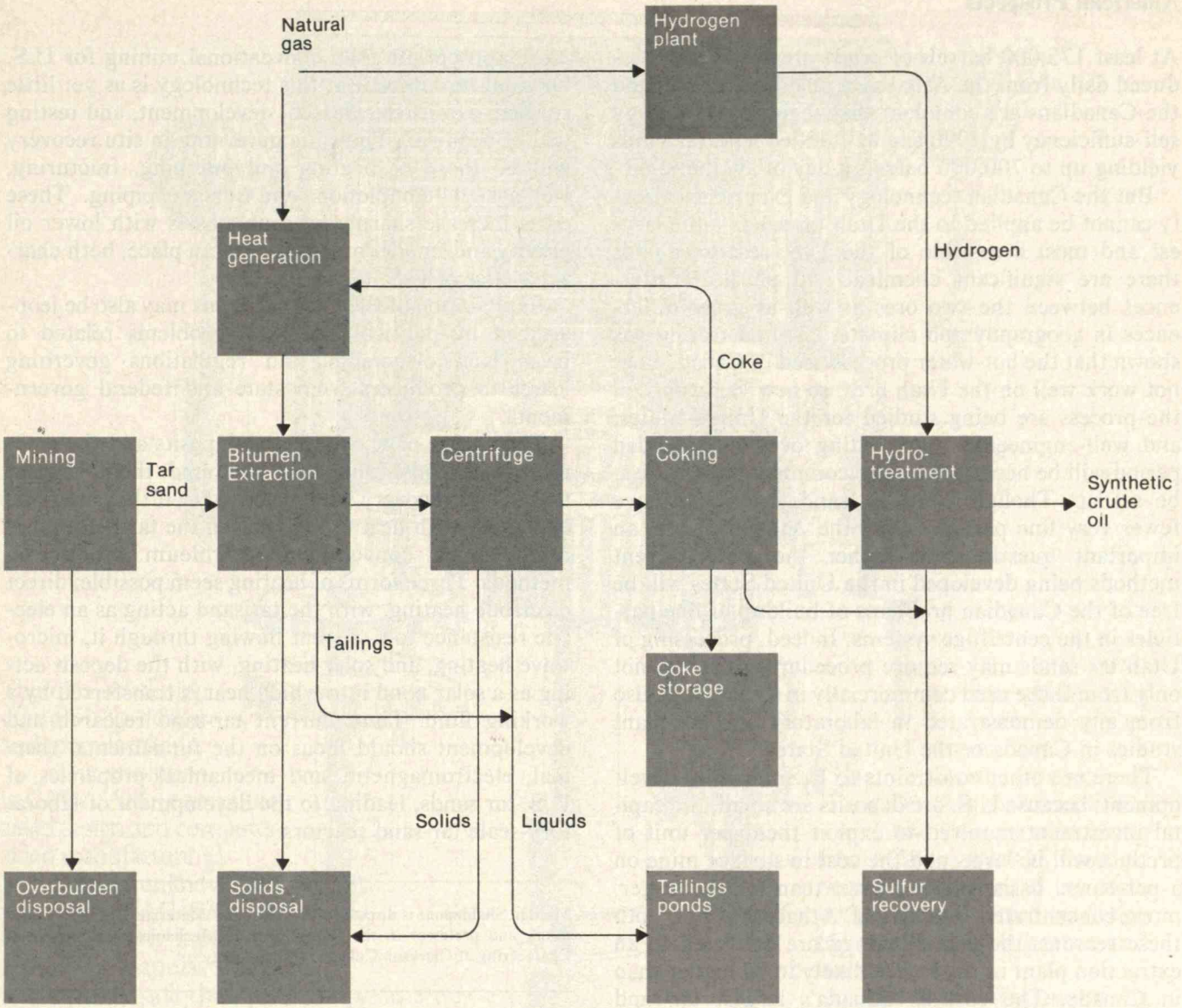
Several solvents capable of reducing oil viscosity are available, but they are generally more valuable than the produced oil, so economic success requires a high percentage of solvent recovery, which is often difficult and expensive to achieve. Reducing viscosity by forcing hydrocarbon gases or carbon dioxide through the bitumen formation is probably impractical because the high pressures required could probably not be maintained at the relatively shallow depths of the tar-sand deposits.

Thermal recovery methods involving the injection of hot water, steam, hot solvent, or gases, or the use of in situ combustion share a common strategy: the bitumen is heated to lower its viscosity so that it flows through the sand to a point of collection. In in situ combustion, the heat is actually generated in the tar sand by combustion of a portion of the bitumen, while the unburned bitumen is drained off and collected.

All in situ recovery methods require penetration of the tar sand by recovery agents, or by oxygen in the case of in situ combustion. Tar sand having 30 percent porosity and a bitumen content of 9 to 10 percent by weight (60 to 70 percent of pore volume) has sufficient permeability for these methods. However, as the oil saturation increases above 80 percent of volume, permeability is inadequate to permit the injection and flow of the heat or fluids required for in situ recovery. Under these conditions, permeability must be induced by fracturing, typically accomplished by drilling and blasting.

The author is now studying a new concept for energizing tar-sand deposits in situ by giant electrodes, which would heat the deposits in much the same way as sand is melted by modern glass industries.

Processing surface-mined tar sands. Hot water is the basic agent for softening and extracting bitumen from the sand. The liquid emerging from this process is a mixture of water, bitumen, and fine solids, and centrifuging is used to separate these three fractions. Once isolated, the bitumen is a heavy oil requiring further processing—coking (dissolution) and hydrogenation—before it is suitable as a synthetic crude oil. Sulfur can be removed during this process, and some fuel value is used to heat the hot water required in the extraction process. Using variations on this general process, two Canadian plants are now producing together some 150,000 barrels of syncrude a day from surface-mined tar sand in the Athabasca area of northeastern Alberta.



Environmental Risks

Severe environmental impacts have accompanied production of bitumen from tar sands in Canada. In addition to the environmental damage from strip mining and water pollution, there are liquid and solid wastes in the form of spent sand and fluid tailings—unrecovered bitumen suspended in sand and clay particles. In general, the solid-waste and land-reclamation problems can be managed with the same strategies successfully applied to surface coal mining, but the Canadian producers admit that reclamation of the tailings ponds is an unsolved problem. The quantities of emissions to air and water from tar-sand mining would depend on the recovery processes used, but existing control technologies would be adequate.

On the basis of methods tested to date, potential environmental impacts of producing oil from tar sands by in situ methods would be very similar to those of conventional oil-field operations, and from this point of view in situ production of tar sand would be preferred over surface mining. Facilities for upgrading the bitumen recovered from tar sands pose environmental problems similar to those of coking and hydrotreating processes in a conventional oil refinery.

American Prospects

At least 175,000 barrels of crude are now being produced daily from the Athabasca fields in Canada, and the Canadians are confident that their goal of energy self-sufficiency by 1990 can be fulfilled with tar sands yielding up to 700,000 barrels a day of synthetic oil.

But the Canadian technology and experience clearly cannot be applied to the Utah tar sands—the largest and most accessible of the U.S. resources—for there are significant chemical and physical differences between the two ores as well as great differences in geography and climate. Limited testing has shown that the hot-water process used in Canada does not work well on the Utah ores, so new variations on the process are being studied for the United States, and well-engineered pilot testing over an extended period will be necessary before commercial plants can be set up. Though Utah tar sands appear to have fewer very fine particles than the Athabasca ore, an important question is whether the water-solvent methods being developed in the United States will be free of the Canadian problems of buildup of fine particles in the centrifuge systems. Indeed, processing of Utah tar sands may require procedures different not only from those used commercially in Canada but also from any demonstrated in laboratory or pilot-plant studies in Canada or the United States.

There are other constraints to U.S. tar-sand development: because U.S. ore deposits are small, the capital investment required to exploit them per unit of product will be large, and the cost to surface mine on a per-barrel basis will be higher than for the larger, more concentrated deposits of Athabasca. For both these reasons, the cost of mined ore delivered to an extraction plant in the U.S. is likely to be higher than in Canada. The cost of Canada's largest tar-sand plant, producing 100,000 barrels a day, was $2.3 billion; the next plant built with the same capacity will cost an estimated $5.1 billion. Most processes proposed for recovery of the synthetic crude from tar sand involve high water consumption, and since the most promising tar-sand deposits in the United States are in arid regions, this problem alone casts considerable doubt on the likelihood of exploitation of U.S. resources by surface mining.

The Canadians are currently producing oil from the Athabasca fields at about $25 to $30 per barrel, quite competitive with world market prices of about $32 per barrel. However, use of the same type of hot-water process in U.S. tar sands may cost as much as $45 per barrel. Thus, in situ production may be far more appropriate than conventional mining for U.S. tar-sand resources. But this technology is as yet little studied; extensive research, development, and testing will be required. The costs governing in situ recovery will be those of heating and pumping, fracturing, well-system completion, and surface piping. These costs increase sharply on a unit basis with lower oil gravity and smaller amounts of oil in place, both characteristics of U.S. tar sands.

Exploitation of the Utah tar sands may also be jeopardized by political and legal problems related to basic land ownership, and regulations governing leases to producers from state and federal governments.

The nature of U.S. tar-sand deposits and the environmental constraints that surround them suggest that in situ recovery will be necessary if they are to be exploited, with heat used to soften the tar before it is removed by conventional petroleum production methods. Three forms of heating seem possible: direct electrode heating, with the tar sand acting as an electric resistance to a current flowing through it, microwave heating, and solar heating, with the deposit acting as a solar pond into which heat is transferred by a working fluid. Thus, current tar-sand research and development should focus on the fundamental thermal, electromagnetic, and mechanical properties of U.S. tar sands, leading to the development of laboratory-scale tar-sand reactors.

Mohsen Shahinpoor is director of the Granular Materials Research Laboratory and professor in the Department of Mechanical and Industrial Engineering at Clarkson College of Technology.

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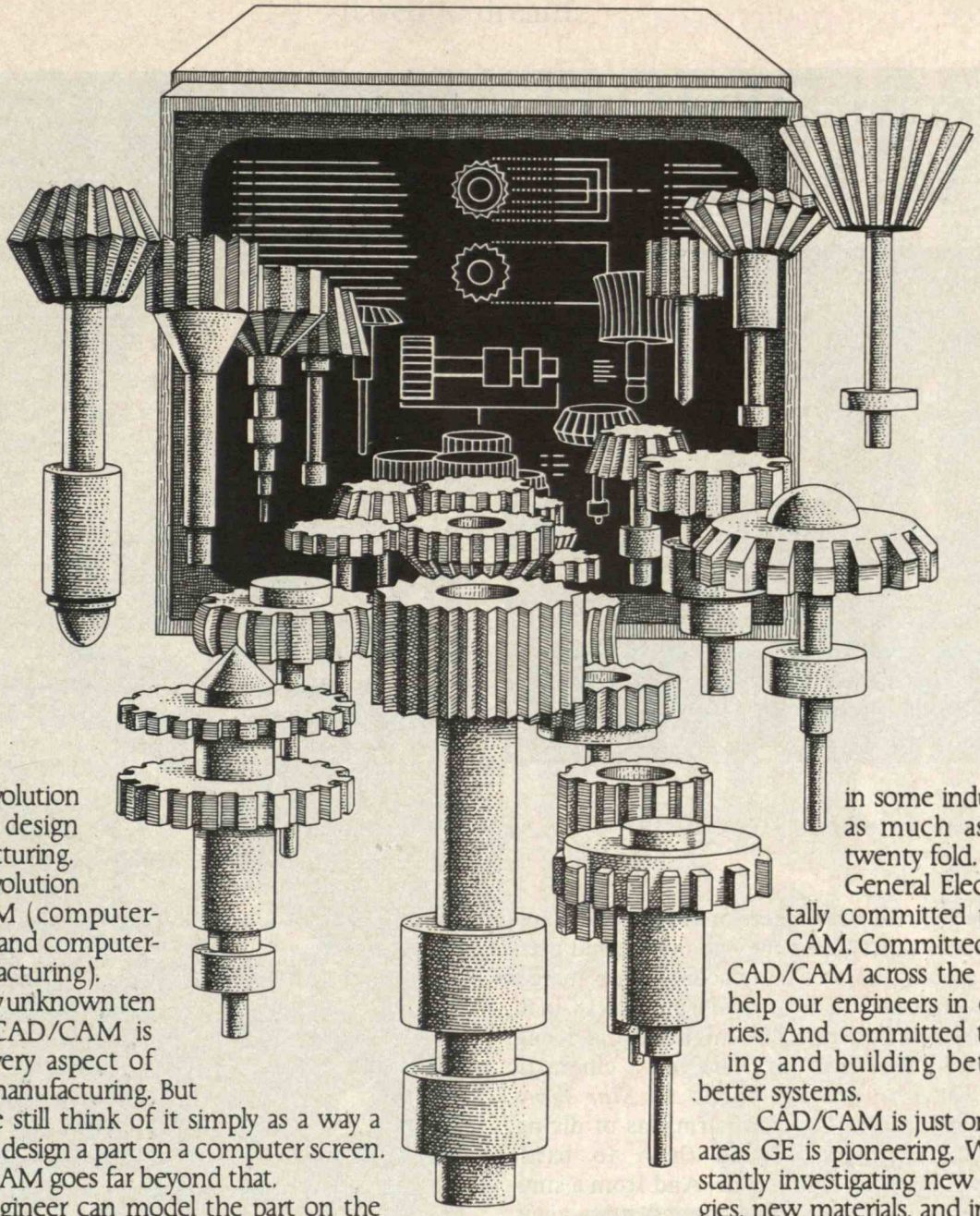

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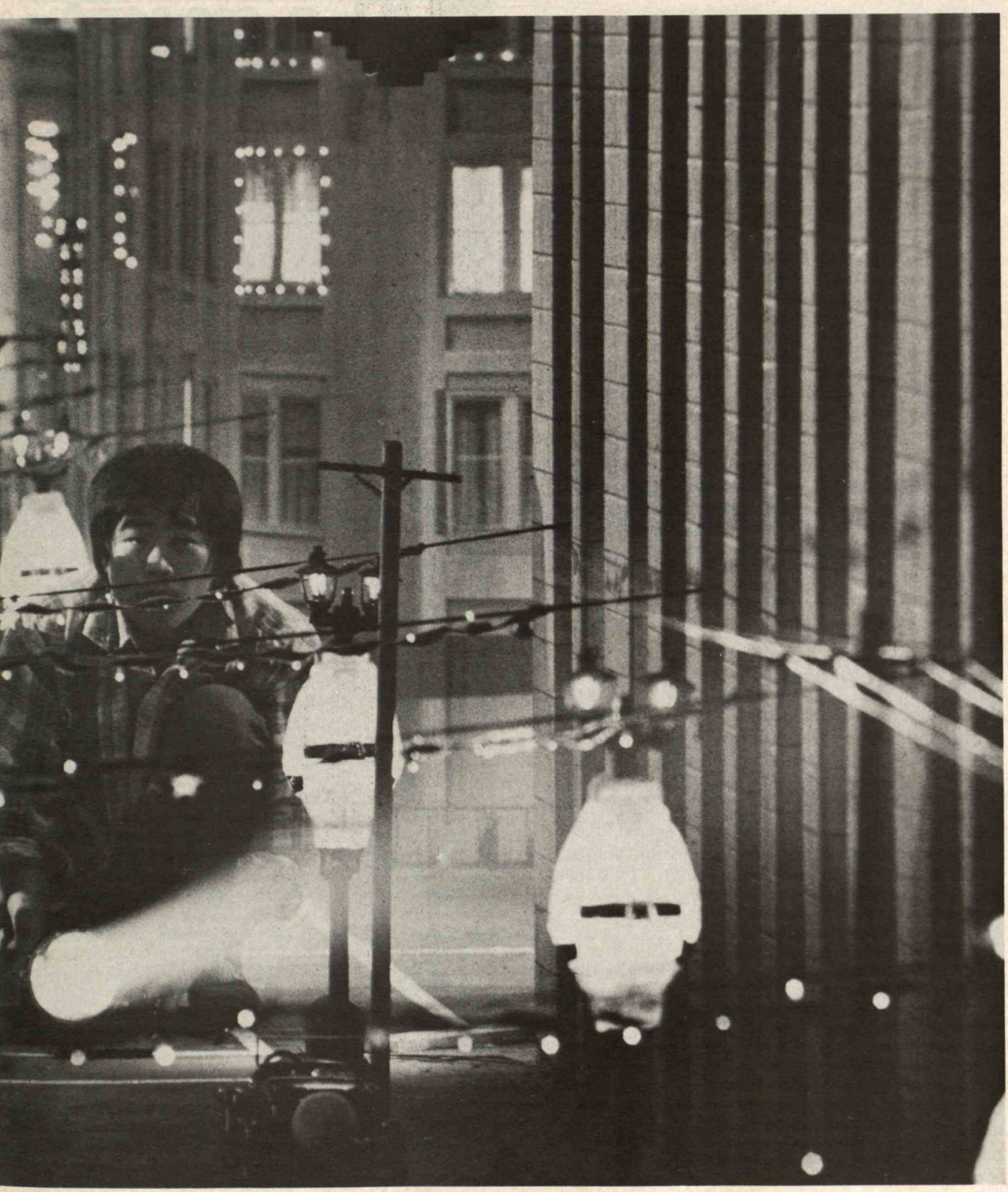
Special Effects in the Movies

by Dennis Meredith

THEY are the real filmmakers of Hollywood—special-effects artists—for they go far beyond mere pictures of actors and scenery to conjure up images that have never existed. They transformed an 18-inch, rabbit-fur-covered doll into the mighty King Kong. They parted a "Red Sea" of Jello for a cinematic Moses in *The Ten Commandments*. In *Star Wars*, they made small plastic toys into armadas of diving, screaming spacefighters, setting them to battle around an evil, looming Death Star. And from a similar conglomeration of parts they rigged up a giant, glittering alien Mother Ship for *Close Encounters of the Third Kind* and landed it on earth for the benefit of a beguiled audience.

For decades they have menaced the earth with aliens and fantastic creatures of every description, routinely destroying its defenseless cities, sometimes with the aid of sophisticated technologies but usually with just a camera, some film, bits of plastic and metal, and considerable ingenuity. They have also carried us to other worlds using paintings and intricately constructed model landscapes. With animation, swirling chemicals, and firecracker-sized pops, they

Spectacular film effects are often achieved with prosaic methods. But the creative use of high technology promises images that even the dream merchants themselves have only recently dared to dream.



PHOTOGRAPHS: DON SHAY

Preceding page

A detailed period replica of Hollywood Boulevard was built at MGM's Burbank Studios for 1941. The largest buildings were twenty feet tall, overlooking busy street scenes of radio-controlled cars and trolleys.

have thrust us into laser battles, plunged us down black holes, and immersed us in planet-shattering explosions.

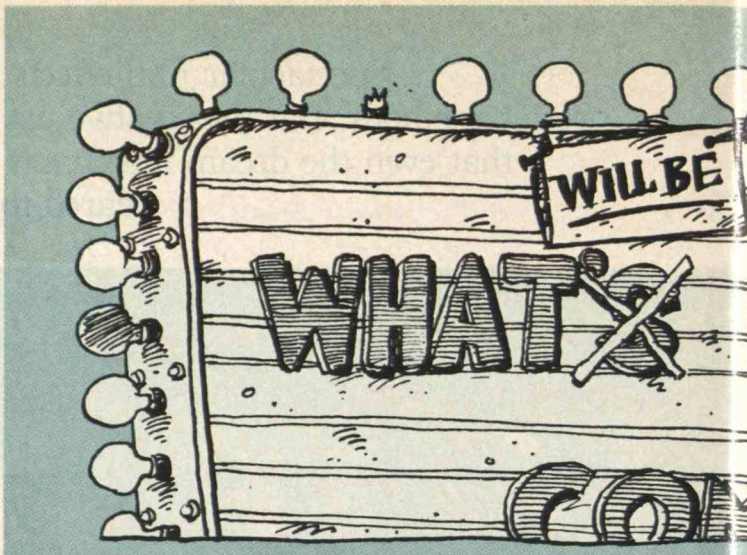
Special-effects artists are among the hottest properties in Hollywood today, for the illusions they create are the film industry's strongest case for luring the public away from its television sets and into the clutches of popcorn-peddling theater owners. And in these days of megabuck movies, special-effects experts have become especially valuable as budget rescuers: they use film tricks to "stretch" sets—with superimposed paintings, for example—and make models that pass for expensive real-life objects. They do their work so well that it is often undetected by the movie-going public, and sometimes these artists perform so brilliantly that even the movie industry misses their work. For instance, although judges for the Academy Awards were impressed by most of the effects for *Close Encounters of the Third Kind*, they sent back one sequence—involving a helicopter search for the heroes—to the technologists who submitted it. There weren't any special effects, complained the judges. But what even these experts hadn't realized was that almost all the helicopter shots were of a model.

Special effects date back to the very beginning of motion pictures and Thomas Edison himself. In his 30-second extravaganza *The Execution of Mary Queen of Scots* (made in 1893), he horrified viewers with an "actual" execution; he merely stopped the camera and replaced an actress on the chopping block with a dummy. Movie pioneers quickly discovered other simple tricks, and in fact many early movies were little more than magic acts set to film. Techniques such as multiple-exposure, split-screen photography and miniaturization were seized upon to thrill audiences with seemingly impossible stunts.

The Model Is the Message

The modern era of special effects, according to many in the film industry, began in 1968 with director Stanley Kubrick's spectacular *2001: A Space Odyssey*. Drawing on many of the basic methods that evolved over previous decades, and developing several completely new techniques, the special-effects team (supervised by Douglas Trumbull, Wally Veevers, Con Pederson, and Tom Howard) was able to set a new standard in the industry with elegant spaceships, realistic alien vistas, and dazzling light shows.

(Continued on page 66)



by Richard Chapman

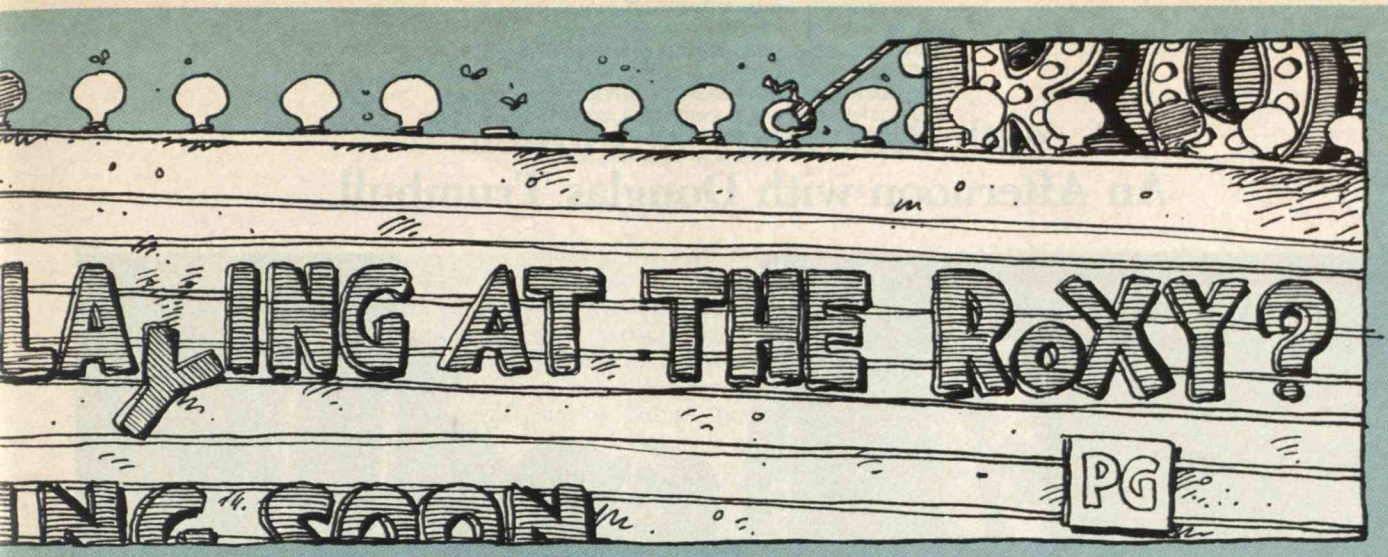
IT'S just another Saturday night at the movies. You pay your $20 and walk into the lobby, where you're greeted by a monstrous creature you've never seen before—a hulking 12-foot, free-form hologram dressed as an usher. Your kids laugh and cavort around the beast, then drag you over to the coin-operated thermography camera, where for several dollars a colorful thermogram of your face will emerge from the slot before your very eyes. There's still plenty of time before the show starts, so you slip off to grab a bite in a quiet geodesic snack dome while watching the kids on closed-circuit TV as they attack the wondrous assortment of interactive video games. In the meantime the sights and sounds of the entire lobby constantly change all around you, thanks to a legion of rear-screen projection modules that shift the background from a tropical rain forest one minute to a barren lunar landscape the next. You look at your watch and realize you've been here an hour and the movie you came to see hasn't even started. You shrug and smile, knowing that it's only a sequel to the show you're already enjoying.

This future theater lobby is not the idle fantasy of some movie-house chain owner playing Jules Verne. It represents only one of many possible designs projected to become reality within the next two years, according to Jerome Armstrong, cofounder of Quantum Leap, a California multimedia production company with plans to radically alter today's movie-going experience. Quantum Leap is in the vanguard of a new wave of film producers and theater designers who are exploring intellectual and sensory stimulation through what Armstrong calls "higher performance delivery systems."

"Our understanding of the effects of film on an audience is Neanderthal," says Armstrong, who combined a background in architectural design with extensive research in psychology and neurology to further grasp how an audience reacts to sound, light, and color. "We are at the beginning of an era of 'sensory junkies.' Whether it's coding in the DNA, or whether it just feels good, there's a general impulse in today's audience to want more stimulation."

Window to Infinity

A growing number of today's filmmakers view audience demand for increased visual stimulation as the only hope for saving the entertainment industry's most endangered species: the neighborhood theater. The competition for movie audiences from cable television, home video cassettes, and a host of other electronic predators has caused the demise of large numbers



of movie houses. According to one industry observer, the number of conventional theaters has dropped nationally from around 20,000 to 13,000.

In addition to competition from the home entertainment market, theaters are also under attack for their high prices and general decline in services and film-print quality. Who wants to pay five dollars to sit knee-deep in dried soft-drink syrup to watch a film scarred with scratches, with color that is already fading? The proliferation of "multiplex theaters," pint-sized subdivisions in which audiences view the film on a screen not much larger than their home TV, has also alienated large numbers of moviegoers.

Rather than grimly forming their projectors in a circle and waiting for the onslaught, filmmakers such as Douglas Trumbull are developing new technologies for the production and exhibition of motion pictures—all designed to get the moviegoer back into the celluloid tent. Trumbull, Hollywood's premier special-effects designer, has developed Showscan, a technique for shooting and projecting film at 60 frames per second rather than the traditional 24. When projected on the giant, 5,292-square-foot Showscan screen, the results are startling. The intensity and the quality of the layered, multisensory image can turn a viewer into a voyeur. Viewers' emotional detachment while experiencing the conventional 35-millimeter, 24-frame-per-second film begins to evaporate and they feel like participants in the scene (*see "Close Encounters with the Master of Illusion: An Afternoon with Douglas Trumbull," page 60*).

Jerome Armstrong and partner Alan Kozlowski will offer the future theatergoer a new experience they call Envirovision, featuring a 360-degree hemispherical projection system. A ten-minute, 70-millimeter film *Sensations* was recently unveiled in Basle, Switzerland for exhibitors from around the world. Projected on a dome 40 feet high and 70 feet wide, the audience was literally surrounded by image and sound. "The entire dome is covered with speakers. It's the same thing we experienced as children in a planetarium. It's like a window to infinity," says Armstrong.

Quantum Leap plans to establish its first "theater of the future" within the next 18 months. Because of prohibitive construction costs, Armstrong foresees his future theater rising out of the shell of an existing traditional movie house, which will be redesigned to accommodate radical new components. This theater will feature an 80-foot curved screen—two and a half times the size of the average 35-millimeter screen—that will reach from floor to ceiling. His goal is to fill in as much of the audience's peripheral vision as possible: "In a traditional theater, your brain is still thinking about everything you're seeing out of the corner of your eye—the walls, no-smoking signs, the brass Indian goddess in her alcove. All this dilutes the impact of the visual experience."

Sound will also be a critical element. The company's theater of the future will have a sound system incorporating 340 speakers with computerized signalrouting, so the audience will be able to experience a sound coming from a distance and follow it as it moves around the theater.

Houses Built for Dreams

What other future theaters will be competing for our time and money? The IMAX/Omnimax system currently operates 25 theaters in the U.S. that feature the unique capability of giant projection: crystal-clear images towering three stories in height and over 100 feet wide. Among notable IMAX screens currently in operation are those at Caesar's Palace in Las Vegas and Marriott's Great America theme park in Santa Clara, Calif.

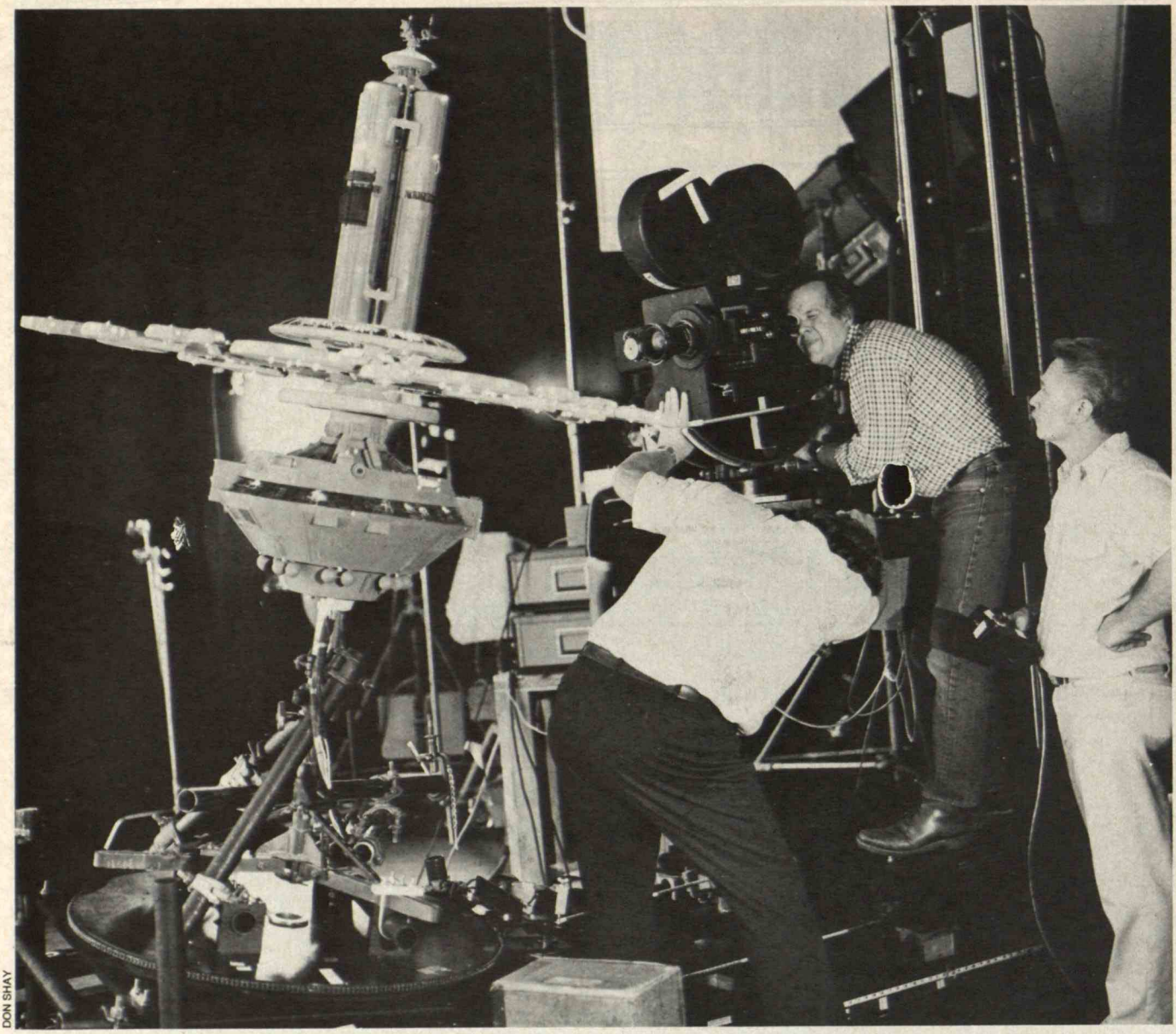
Ivan Dryer, president of Laser Images, which presents Laserium light shows in Los Angeles and nine other cities, plans a theater called Pyradome, with a 90-foot domed screen installed inside a pyramid designed to hold 500 people. The audience will recline in custom-designed seats and be totally surrounded by sound, light, and color.

As the video revolution invades the entertainment industry, the theater of the future may be faced with the ultimate irony: displaying television pictures instead of film. With newly developed high-definition television broadcasting capabilities, featuring more than twice the resolution of existing systems, filmmakers can project images onto large movie screens. These new movie productions would use high-resolution videotape and probably be broadcast directly via satellite, eliminating the costly and time-consuming distribution process now sharply criticized by theater owners.

Despite the optimism and enthusiasm of their creators, the "theaters of the future" remain just that, and it may be a while before die-hard movie buffs are forced to salt their popcorn with nostalgic tears. But there is no doubt that the old movie palace is under siege from the new electronic horde battering at the rococco, bejewelled portals. These houses were built for dreams, and dreams are what fuel the future. □

Richard Chapman is a screenwriter/producer with Universal Studios and is currently producing "Simon and Simon," a new CBS television series.

Close Encounter with the Master of Illusion: An Afternoon with Douglas Trumbull



DON SHAY

WHEN director Stanley Kubrick chose Douglas Trumbull to develop special effects for 2001: A Space Odyssey, *he was working in a small "effects house" in Hollywood producing space scenes for NASA training films. But he was lost forever to NASA when* 2001 *hit the theaters. Trumbull's waltzing, detailed miniature spaceships, convincing moonscapes, and dazzling light effects assured him a place in cinematic history; many in the film industry consider the "modern era" of special effects to have been ushered in with* 2001.

Trumbull went on to oversee special effects for a movie he directed himself, Silent Running, *and then to work with director Steven Spielberg on* Close Encounters of the Third Kind. *His next major project was the movie* Star Trek, *a harrowing nine-month race to complete nearly 500 special-effects shots.*

Trumbull has lately busied himself developing a new filming technique—Showscan—that he claims will enable movies to compete with advances in television technology, and in directing his second film, Brainstorm *(which the studio canceled late in production because of the tragic death of its star, Natalie Wood).*

Writers Dennis Meredith and Richard Chapman recently visited Trumbull's studio—Entertainment Effects Group—a nondescript industrial building in Venice, Calif. that looks like just another warehouse. But inside is a 20,000-square-foot facility where wondrous images are brewed: artists, film technicians, electronics experts, and a complex array of equipment. For example, that day one group of technicians was using sophisticated motion-control equipment to shoot detailed miniatures of a futuristic urban landscape for the upcoming film Bladerunnner. *In another area, an artist carefully painted individual mattes for hundreds of film frames to depict the futuristic details of a space vehicle's dashboard.*

Douglas Trumbull became director of special effects for *Star Trek—The Motion Picture* only nine months before its world premiere; his extensive research and development under such time pressure are now legendary in the business. Here he is shown lining up a shot of a model office complex in space.

When Worlds Collide

TR: Since special effects is an area where technology meets art, can you tell us about some of the problems moviemakers have in dealing with special-effects engineers?

Trumbull: The biggest problems we have are those of differences in interpretation. These kinds of projects can go farthest awry when the director doesn't see an image in his or her mind quite the same way that the special-effects person, or the director of photography, or the actor, sees it. The situation is like the story of *Rashomon* sometimes, with everyone seeing the same thing differently. The most important way to prevent these misunderstandings is to be able to rapidly and accurately visualize an effect before we invest thousands of dollars in it. But that's not always possible, because what we do often does not exist before we've done it.

For instance, the V'ger cloud sequence in *Star Trek* was almost impossible to illustrate beforehand. You couldn't sit down with a pencil and do a drawing and show the director what it was going to look like. It was the same with the light-trip sequence in *2001*. Rushing through those corridors of light was an effect that does not exist in the real world, and it existed on film only after the camera went through a very complicated exposure technique based on an idea that I had in my head (but that Kubrick didn't have in his).

TR: You've said elsewhere that in *2001* director Stanley Kubrick allowed the special effects to "build" naturally. Was this an example of the best sort of cooperation between the director and the special-effects person?

Trumbull: Yes, Kubrick had a very specific goal in mind. He wanted to create a huge, important, even classic, nonverbal art experience. That movie doesn't have very much of a story. It's an art movie, and even though nobody working on the movie, including myself, knew how to do the special effects required, we all said "OK, let's figure something out; let's invent something new; let's do something a different way." And Kubrick is a sort of contrary character, so he was *determined* to do things another way. Even if somebody's done something a certain way for 2,000 years because that's the way to do it, he just rejects that idea out of hand and says "we're going to do something else." In working on *2001* we tended to be wrong more often than not—the shooting ratio was about 200 to 1; a lot of stuff didn't work—but we did have a certain rate of success. We were able to achieve something new and different.

And a lot of experiments that were really quite bizarre—and that, in my opinion, would have expanded *2001* even further—never got into the film because we were running out of time at the end. For instance, we did a good deal of research into the literature on extraterrestrials and we tried a lot of wild ideas. We started coming up with some things at the end that were really quite extraordinary—they really started coming to life, so to speak—but we just didn't have time to "optical" them into the movie.

TR: What about *Close Encounters*?

Trumbull: *Close Encounters* was a very good experience because Spielberg and I were contemporaries and could agree very rapidly on how things should look. We were able to avoid a lot of time and money problems that way. He was very pleased with what we did: we at least matched his idea of what he wanted, and we often surpassed it. We really pulled off a lot of nice-looking effects.

TR: Are you often surprised that what you visualize is different from what actually occurs?

Trumbull: Oh, yes. Sometimes you have really nice serendipity and get secondary effects. And sometimes it doesn't live up to what you expected.

TR: There's a fascinating story going around about Spielberg's idea for the Mother Ship in *Close Encounters*. It was said that he went up to Mulholland Drive overlooking Los Angeles one night, and while lying upside down on his car looking down at the city, he conceived of the Mother Ship as a ship of lights. Is that true?

Trumbull: Yes, but that was not the first idea. When I came on the picture, they already had a sort of general design for the Mother Ship that looked like a black kazoo. It was the ugliest-looking, stupidest, oddest-shaped thing you could imagine. It had no lights on it at all, and it had a door that would open up and project a stream of light sort of like a solar eclipse. It took a lot of evolution to finally come up with what we did.

TR: One way of preventing misunderstandings between the special-effects engineer and the director is for them to be the same person. Did you direct *Silent Running* so that you could pursue your own vision?

Trumbull: Yes. *Silent Running* was my reaction against *2001*, which had taken three agonizing years of my life, and I just decided that I couldn't stand to work for anybody ever again. I was also reacting against that cold, cerebral sterility of *2001*. I didn't see space as being sterile. I saw it as a place where people would be dealing with other people, and it would be sort of funky and dirty.

TR: Did George Lucas first get from you the idea of the "used future" that he used in *Star Wars*?

Trumbull: Well, yes, I think I was the first guy to do the used-future look. We rented this old aircraft carrier *for Silent Running*, changed it around to make it look like a space ship, and made it seem sort of homey and "down to earth." *Silent Running* was a very low-budget film—no new special effects—but it achieved a kind of reputation for its special effects because of its look. There was an emotional feel about it, very unusual for science-fiction films, that I was trying to get at.

Enormous Changes at the Last Minute

TR: Is it a general case that new effects technologies aren't developed unless the technologist is put on a picture in which the director *demands* new special effects?

Trumbull: Yes, one of the problems in the movie industry is that there aren't any effects divisions of major studios (except for a small one at Disney), so there's no continuity of development within the studio. Therefore, if you want to do something a little different, and perhaps make a breakthrough, you have to do it on a particular movie. And you have to be able to write off all the R&D and construction costs against the budget of that film. It's a good way to work if you can pull it off, but the pictures that can tolerate that level of expenditure are rare.

TR: Are the costs of those developments higher because they have to be done on a crash basis?

Trumbull: Yes. It varies, depending on how well organized a picture is. A lot of pictures just start plugging in the effects at the last minute and that's when it gets horrendously difficult, as in *Star Trek*.

TR: Was it the case with *Star Trek* that the previous special-effects team [before Trumbull and associates took over] tried to develop new technologies and failed?

Trumbull: Yes, they had an idea that in theory was very intriguing. When I heard about it, I suggested that it wasn't going to work—that they would have problems—but nobody believed me at the time.

They bought an Evans and Sutherland computer display system and programmed in all the movie's miniatures so that it could

display a model from any angle, with any focal-length lens, at any distance, and with any direction of movement. They also programmed in the capability to superimpose a second image such as a star background or a planet. And they planned to be able to generate virtually any dynamic motion that they wanted by interacting camera movement and model movement.

Their idea was to put up a desired shot on the display screen, move elements about with a joystick, and by specifying the parameters of the scene, be able to generate a tape that would show them what the shot would look like in graphic form. The computer would then generate control tapes, which they would give to the camera department, and the cameras would automatically shoot the real model.

In reality, that whole concept is unworkable. Given a display with such little information, it is absolutely impossible, in my opinion, to make valid aesthetic judgements about how the model should move, or how fast a scene should occur, or any of the other dynamics in a shot. And in fact, as soon as they got the system up and running in a very preliminary form, they observed several things that I had predicted. They found that what went on film, with a lit and detailed scale model, not only looked totally different from the graphic display but in fact didn't work. They might realize, for instance, that the model should move more slowly to give a different feeling of weight, volume, and perspective. But their setup made it impossible for the camera operator on the stage, who had to deal with the relationship between the camera and the model, to modify the tape; there was no terminal to allow the camera operator to interact with the program. The entire sequence would have to be scrubbed and the tape sent back to the computer for reprogramming.

TR: Aesthetics aside, weren't there also some basic mechanical difficulties?

Trumbull: Yes. This group had never photographed models before, and they didn't realize that you couldn't take a model of the spaceship *Enterprise* and just move it on a mount by itself. One of the facts of life we deal with in this business is that if you have a miniature that is highly detailed and "aged," with a lot of tiny grain-of-wheat bulbs and quartz lights and other such things built into it, the kind of lighting you need for that miniature is very complex.

There are big soft lights on one side that might be behind a large transparent plastic sheet 8 feet by 10 feet. On the other side

Douglas Trumbull and director Steven Spielberg reviewing special-effects footage during *Close Encounters of the Third Kind*.

there might be a big 10,000-watt lamp that weighs 250 pounds on a stand that's 15 feet in the air. There might be 20 other small lamps putting little gradations of light and shadow onto the miniature at very precise locations. And then there might be equipment to project a movie *into* the miniature—say, of two guys at the controls. Since this whole setup is very cumbersome, you face the reality that it can't move at all; all the motion has to be generated by the camera. And since the team's control tapes called for the model and all its lights to move, they were just totally unusable.

TR: Would you describe this as a case of the technology running away from the filmmaking?

Trumbull: Yes, they actually said that they wanted to do the entire project through this technology and never have to go on a stage or look through a camera lens. And that was a total denial of aesthetic judgments that, to me, play the larger role in the equation.

The various technologies, such as control systems, are simply tools to create an illusion. But the illusion itself is a composite of many art forms—of lighting, perspective, detailing, color, shadowing, and reflections—all kinds of subtle factors that even the greatest, most powerful graphic-display systems cannot achieve alone.

In the special-effects business today, there's rampant development of motion-control systems by technologists who believe that this is really the way to go. The kind of equipment used is very similar to numerically controlled machines and industrial robots, and those techologies are advancing by leaps and bounds in terms of accuracy and the ability to sense position. But you tend to get a lot of special effects being produced by people who are dominated by engineering and mathematics and computer design, who aren't artists and know very little about painting; they haven't studied the great masters, for example. Although they may make good hardware, they don't make very good special effects.

To Play an Image

TR: In *Brainstorm*, you appeared to be taking a different direction. It was a story about direct brain-to-brain communication of sensory experience that involved a different realm of special effects, is that correct?

Trumbull: Yes, *Brainstorm* was a challenge I set for myself because I just got very tired of shooting spaceships and star backgrounds and that sort of stuff. It's become almost a manufacturing, cut-and-dried business. Not that it's not difficult and doesn't still require a lot of technique, but it's just more of the same to me. *Brainstorm* would have featured real, concrete, and recognizable imagery but totally fantastical—like a surrealist painting. We were trying to put together some complicated composites to create imagery that seemed to come from Never-Never-Land.

There was one sequence in *Star Trek* that was something of a warmup exercise for this—when we were flying through all these soft, diaphanous clouds. Nothing about that scene really existed as something you could look at or touch as a piece of artwork. It was all formed inside the camera as a series of multiple exposures at different distances, using motion control to create all the spatial movements of artwork and sources of light.

We've certainly got a lot further to go with it, but that was the first experiment in using artwork as the visual input and high technology as the control system—interfacing art with technology. I could have tried to generate a sequence like that with the computer alone, but to go into a total use of graphic-display systems and electronic image generation requires an involvement in programming techniques and mathematics that's just not my bag.

TR: George Lucas and his colleagues at Industrial Light and Magic are heavily committed to graphics-display techniques for special effects, aren't they?

Douglas Trumbull directing actor Bruce Dern in *Silent Running*.

Trumbull: Yes, they're trying to make some headway in graphic-display development, and I think they're going to come up against some problems. For instance, if graphic-display systems are ever to develop into an art form, there will have to be a way for the artist to interact directly with the system—a way that doesn't require him or her to be a programmer. Human beings are very specific: rarely do you find a person who is both a perceptive artist and a mathematician. The two talents don't tend to occur in the same individual, and you have to allow for these differences in building artistic devices.

If you're going to make a music synthesizer, for instance, it's best to put it in the form of a keyboard that a pianist can play. Similarly, a graphic-image synthesizer might feature the equivalent of a light pen, allowing the artist to draw strokes of varying width, size, density, and color onto a screen. And the artist would also need controls for the other hand—to determine spatial distance, for instance. You could specify that one stroke be 50 miles away, and another stroke 3 feet away.

TR: You would be able to "play" an image, in other words.

Trumbull: Yes, and once you've executed your drawing, the computer could show it to you from any angle. When computer-graphics systems have those kinds of capabilities, artistic magic is going to happen. But when the image has to be put into the form of a mathematical computation, you're not going to connect with artists.

Innovation and Information

TR: If you had a wish list of new techniques for filmmaking, what would be on it?

Trumbull: One of the first things I would like to have—which I understand is being worked on now—is what's called an electronic composite printer. This could take two pieces of photographic film, read them digitally, store them in computer memory as very high-resolution color images, and then combine them into one image.

In the movie industry, we are constantly using a process called "bluescreen" in which we make composites of one image in front of another. We currently have to do this photographically. We'll shoot a foreground person, for example, against a blue screen. Then we'll use the blue emulsion on the film to pull out a black-and-white image of just that silhouette so that we have a mask with which to put the two images together. It seems to me that to do all this electronically would be very easy.

TR: But aren't the resolutions of electronic systems quite low in comparison with optical systems?

Trumbull: Yes, but in theory you could develop imaging systems with a large-enough capacity to process high-resolution pictures. Using just the visual techniques that have come out of the space program (for reprocessing planetary images), you could do an image composite much better electronically than optically.

Film stock has certain chemical properties that you're stuck with. But electronically, you can use all kinds of new properties. You can define gray scales arbitrarily; you can make one color merge into another; you can direct a computer to go through a whole series of evaluations and cause images to blend together in a very realistic way. You can create a composite that's much superior to what is done photographically now.

I'm really looking forward to the availability of that kind of hardware in the near future. The optical printer is a major limiting factor in our industry, and I'd like to take the next step away from it.

TR: Do you want to get away from film altogether?

Trumbull: I would be pleased to, but there are several limiting factors at present. Movies are projected at 24 frames per second—a convention we're stuck with—which requires blur on each frame of the film. Each frame cannot be sharp, or else the picture looks very stroboscopic and cartoonlike. Purposeful blur is thus built into the exposure.

But one of the problems with electronic storage systems is that they tend to store an image at one instant in time rather than over a period of time. And so far, there's no way to include blur in an electronically stored image.

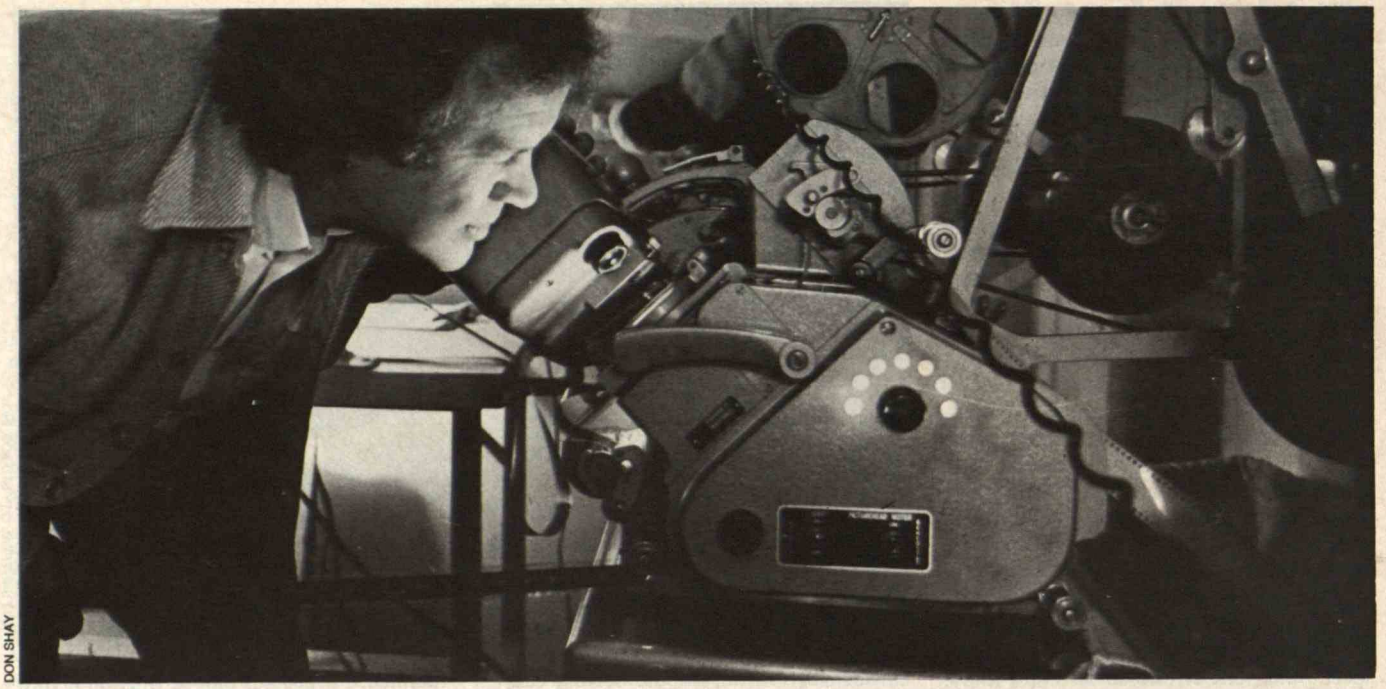
TR: How about using videotape? Sony has come out with a high-resolution video system that Francis Ford Coppola has said he wants to use for his movies. Do you think such systems will be useful?

Trumbull: I think it's definitely the way the movie industry is going to go, with the transition occurring over the next decade. But for the next few years special effects will be a hybrid—a mix of film and electronics—because theaters still project film and we're still working with film.

TR: You don't think the movie industry would switch to video systems for theaters if they were available?

Trumbull: My experience with the movie industry is that if you walked in the door today with a 3-D, high-resolution, holographic movie-in-the-round system that worked perfectly, and you offered 150 projectors to theaters rent-free, you would still be 20 years away from getting it to the public. Out there in Arkansas they're not equipped to show it—they're just not thinking that way. And the industry is not electronically equipped, managerially equipped, or even dramatically equipped either. Performers have to be ready, too. Any such innovations developments are

When artists can interact directly with computerized systems in ways that don't require them to be programmers, artistic magic is going to happen.



DON SHAY

going to take a lot longer to become established than people suspect.

TR: So any advance today still has to be compatible with the current film-projection equipment.

Trumbull: Yes, if you want to go into theaters. But I don't think it's going to be very long before somebody has a relatively high-resolution, bright, clear electronic projection system for the theater. That strikes me as just around the corner.

TR: This brings us to Showscan. Since it's simply a system of shooting and projecting film at the faster rate of 60 frames per second, it doesn't seem to be very difficult to adapt to current theaters. But, we understand it has not been well received.

Trumbull: I've been dumbfounded by the industry's total rejection of such a simple system. I'm not asking the theaters to burn all their seats or lift the roof off, or do anything that's totally incompatible with existing processes and technologies. Film processing, editing, production, sound mixing, lenses—all would remain the same. It's simply a way of increasing the density of information that your eye perceives.

One of the things about 24-frame-a-second film is that it puts a little barrier between the audience and the movie. In filming at 60 frames per second, you create an image that's so lifelike and three-dimensional that you no longer feel you're just an observer. There's no veil; you become a virtual participant in the scene.

But I've been caught in a vicious circle with Showscan. I went to the studio and said "let's make *Brainstorm* in Showscan," and they said "great, but none of the theaters are equipped to show it." So I went to the theaters, and they said "well, we don't want to change over our projectors and screens because the rest of the movie industry is not making movies that way." I went back and forth, meeting with one group and then the other, trying to get them connected, but to no avail. All the studios would have to commit themselves to making movies that way so that theaters could then justify the expenditure.

One of the big problems we have in the movie industry is what we've come to call "the consent decree"—an antitrust suit in the 1950s that was against Paramount Pictures but that applied to all the studios. That suit made it impossible for the studios to own their own theaters. When production and distribution of films became totally separate from exhibition of films in theaters, technological innovation in the industry stagnated.

Just before the consent decree there was a slew of new developments: Panavision, Super Panavision, Ultra Panavision, Cinerama, Todd-A-O, D-150, Circlevision, Techniscope, Smellorama. Everybody was going crazy. The industry just blossomed with all kinds of wonderful and amazing theater effects. After the decree the industry just stagnated. I'd really like to see the federal government abandon that law.

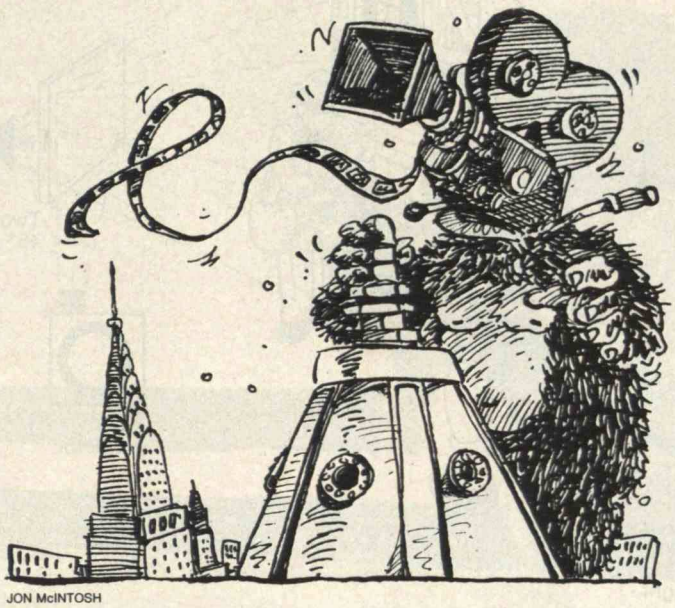
TR: Given the innovations in television technology occurring today, do you think that movies can still compete?

Trumbull: Absolutely. First of all, putting something dynamic up on a giant screen in a theater is a unique form of entertainment—filmed movies are a riveting medium. It's also a kind of social interaction, with people experiencing something as a group.

To illustrate the differences between movies and TV, take a "high-density" 35-millimeter movie. It has very fine photography, sharp lenses, a lot of depth of field, excellent performances, tight editing, a very complex sound track—all the art forms that come together to make a movie. Put that film on television and almost everyone will admit that something is lost, but still it works OK.

But the process doesn't work in the other direction. You can't take what we accept on television and put it up on a big screen in a theater: the content is not there; the ideas are not there; it's terribly lit; it's not well photographed; it's not tightly edited; and most important, it's inherently a different form. The theater audience, which is much more discriminating than the TV audience, is looking for higher levels of performance in every element. □

Adventures in Special Effects: Hazardous Oatmeal and King Kong's Pliers



JON McINTOSH

THE world of special-effects artists is decidedly peculiar. It takes a lot of eccentric ingenuity and tinkering to fool all of the people all of the time. And some of the adventures *behind* the camera are more fascinating than the action in front.

There Are Thrills . . .

For instance, nothing is quite as sobering as being trapped, Perils-of-Pauline style, in front of several hundred pounds of automated camera bearing down on its sometimes unprogrammed rounds. From effects artists' descriptions, these electromechanical beasts could star in their own monster movies:

"The system only has to have a fly speck or the tiniest mark on one of its floppy discs for it to read the wrong information and suddenly go berserk," says veteran effects man Peter Ellenshaw of the Disney automated camera effects system. "And if that happens, you musn't be standing too close."

Besides escaping from sneaky cameras, effects artists find themselves dodging lasers, electrical arcs, explosions used in effects shots, and toxic materials used in models and smoke. It all makes for interesting days at the office.

. . . And There Are Spills

Once upon a time, effects artists Gene Warren and Wah Chang had to come up with a realistic lava flow through the streets of London for *The Time Machine*. They decided to use oatmeal as a cheap, realistic substitute, and to run it through a miniature street. After cooking up hundreds of gallons of the stuff one Friday, they went off for the weekend, not realizing that the hot summer weather would ferment the cereal. In their book *Film Tricks*, authors Harold Schecter and David Everitt describe the results:

"When filming resumed on Monday, Warren and Chang unwittingly set up their high-speed cameras at the end of the miniature street and waited for the trap door to open and release the solid flow down the chute. It flowed all right—like a fast-moving river. With their backs literally against the wall, Warren and Chang could only gape in horror as the torrent of watery, foul-smelling breakfast rushed forward to engulf them."

Sometimes, only ingenuity saves an effects artist from disaster. For instance, Schecter and Everitt describe the plight of one artist working on *King Kong*. After a hard day animating a dinosaur model with stop-motion, the technician discovered to his horror that one handle on a pair of pliers he had been using was visible in the scene. Displaying the resourcefulness of a true artist, the technician simply continued to animate the dinosaur while also beginning to animate the pliers, easing them out of the picture frame by frame. In the finished *King Kong*, the pliers can be seen resembling a great gray serpent slithering off to one side of the jungle scene, but because they are away from the center of action, they are seldom noticed.

Cheap Tricks

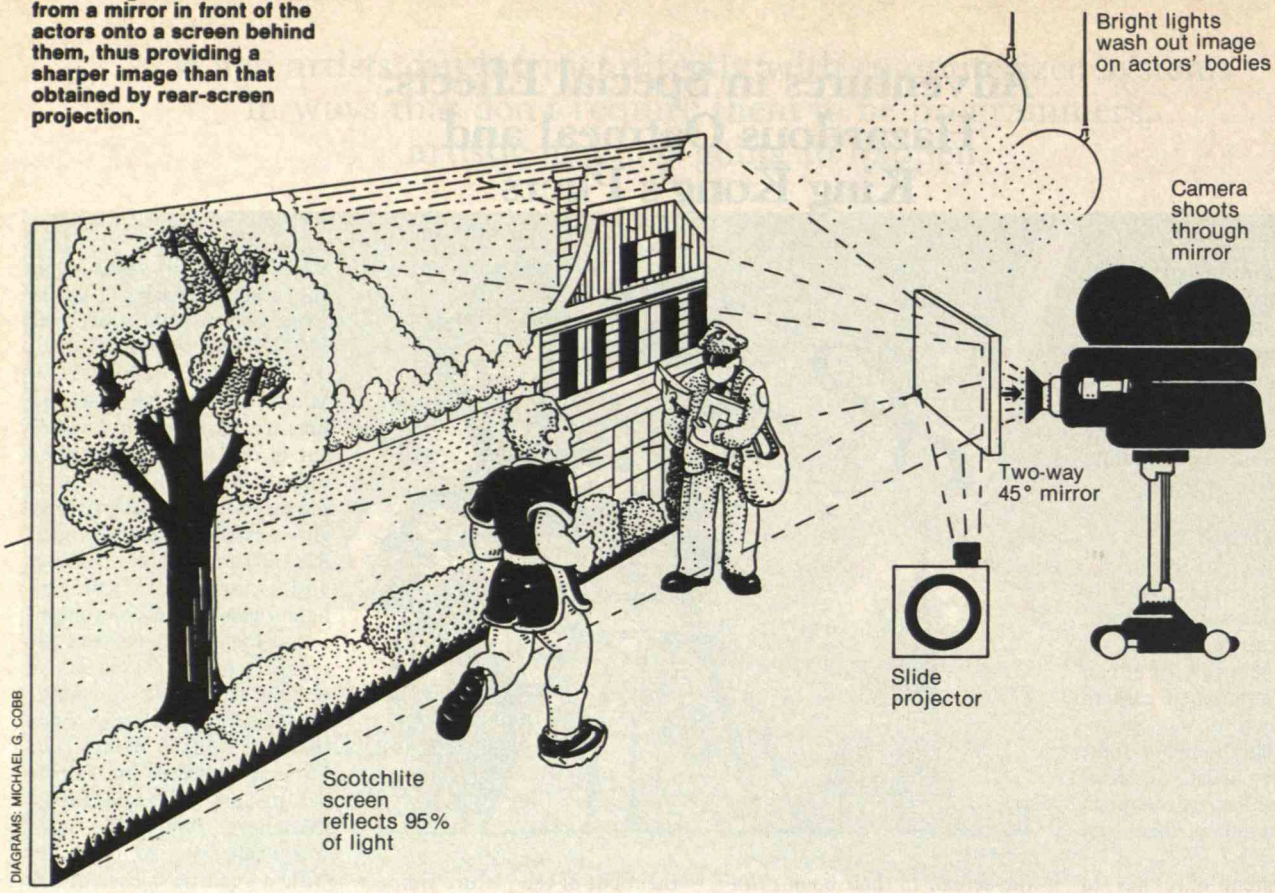
The modeling, painting, and photography of special effects often involves a devastating combination of tedium and deadline pressure, so a little humor goes a long way toward keeping oneself out of a straitjacket. For instance, model-maker Greg Jein and his cohorts spent eight and a half solid weeks working twelve-hour days to complete the four-foot Mother Ship for *Close Encounters*. Included in the process was a hole-drilling marathon in which even the secretaries and director Steven Spielberg were enlisted to produce the hundreds of thousands of windows in the model. After a while, the wearied model crew began hanging all sorts of extraneous gags on the ship, including a miniature R2-D2 robot, a Volkswagen bus, a shark chasing a scuba diver, and a little graveyard with crosses. At one window, the silhouette of Mickey Mouse appears. Most of the gags are not visible in the film, but in one of the first scenes with the Mother Ship, as awed actress Melinda Dillon first glimpses the behemoth craft, R2-D2 can be seen hanging upside down, his little red light gleaming mischievously.

But by far the most satisfying part of special effects is getting something for nothing—figuring out cheap tricks that save loads of money. For instance, Schecter and Everitt describe how the late effects master A. Arnold Gillespie was challenged to come up with a realistic locust attack for the film *The Good Earth*. Gillespie simply poured a can of coffee grounds into a glass tank of water and filmed the falling black particles upside down. When he turned the film right-side up and superimposed it on footage of a farmer's field, the result looked exactly like an ominous swarm of locusts rising in the distance.

Albert Whitlock, the matte painter whose name graces hundreds of films, recalls a cheap shot he did for the sequel of *The Exorcist*. The director needed film of an airplane making its way through a spooky, cloud-filled sky. Whitlock and his helpers conjured up the scene perfectly, not with a real airplane but with one painted on glass, which they filmed using black velvet, cotton, a light bulb, and some pieces of wood.

"We did it for nothing, we did it in an hour, and the whole thing worked," said Whitlock proudly. If ever effects artists build a hall of fame, his remark should be carved in granite over the door.—*D.M.* □

Front-Screen Projection: The background is reflected from a mirror in front of the actors onto a screen behind them, thus providing a sharper image than that obtained by rear-screen projection.



DIAGRAMS: MICHAEL G. COBB

(Continued from page 58)

Special effects can be divided into two categories: stage effects and optical effects. The former include all the special makeup and gadgets used on camera to simulate, for example, the gore, ghouls, and gremlins in the current wave of horror movies. These effects are sometimes quite ingenious, as in the case of "Bruce," the tourist-terrifying mechanical shark in *Jaws*, or the chrome-toothed, reptilian, supremely evil monster in *Alien*. But generally, such constructions and the images they produce are more old-fashioned thespic art than technology; therefore, I shall concentrate here on optical tricks.

Three basic features of film make all optical effects possible. First, the camera can be used as a versatile device for special effects—different speeds and lenses, odd angles, multiple exposures, and quick cutting can make even the most mundane object or situation appear exotic. For instance, the ominous, swirling "black hole" in Walt Disney's recent film of the same name was basically a vortex inside a large water tank, into which various paints were dripped, that was photographed at high speed. Various images of smoke and color were also superimposed over this film to create the final effect.

Second, exposing a piece of movie film is not necessarily a one-shot deal. Using precision equipment and masks called "mattes," special-effects artists can print image after image on the same piece of film, using cameras and light like an artist uses brush and palette. One of the most remarkable recent examples of this art was the breathtaking sequence in *The Empire Strikes Back* in which the heroes' spaceship *Millennium Falcon* screams through a roiling asteroid belt with Imperial fighters in hot pursuit. As the ships weave perilously among the asteroids, the evil Imperial fighters crash spectacularly against the asteroids one by one. To make this sequence, technicians filmed each spaceship and each asteroid separately—along with background paintings of still more asteroids, a star field, explosions, shadows, and lasers—and superimposed all the images on the final print. A total of about 120 separate pieces of film were involved, all of which had to be fitted with extreme precision.

Finally, film is a two-dimensional medium, so that illusions of depth can easily be created using paintings, miniatures with distorted or "forced" perspective, and other visual tricks. For example, practically all of the sprawling vistas of the Midwestern countryside in *Close Encounters of the Third Kind*, including the city-light-spangled backgrounds, were shallow, forced-perspective models shot on a soundstage. In one ironic twist, the filmmakers found they had to use a *model* of Devil's Tower—the famous Wyoming landmark where the aliens land—because footage of the real thing looked too much like a model.

Models often serve as the basic subjects of many

Left:
For closeup scenes, Lucasfilms' art department built an 8-foot tauntaun that could rear back, blink, and snort carbon-dioxide vapor.

Below:
The fictional tauntaun of *The Empire Strikes Back* was brought to life by stop-motion animator Phil Tippett. The puppet was positioned into the desired stance for each frame, and motion-control mechanisms moved the model a short distance during exposure to introduce realistic blur.

Bottom:
The scene of the tauntaun running across the snowy expanse was a superposition of two films: the actual landscape shot from a helicopter and the matted-in action of the model.

DON SHAY

special-effects shots; indeed, they are remarkable examples of what art and a bit of tinkering can accomplish in film. They can be richly detailed, as was the four-foot-diameter Mother Ship in *Close Encounters*, which featured hundreds of thousands of tiny drilled holes to simulate windows. They can be huge, like the 68-foot model of V'ger, the immense alien machine that threatened earth in *Star Trek*. And they can demand prodigious amounts of time and effort, as did the elephantine walking tanks in *The Empire Strikes Back*, which took several workers a year to research, design, and construct.

However, the materials for such models are by no means exotic. One popular way of obtaining parts is by "kit-bashing," in which off-the-shelf toy models are plundered. Thus, the Mother Ship included parts from a model of Jacques Yves Cousteau's research vessel *Calypso*, as well as model train pieces. And the tabletop sets for *Close Encounters* and *1941*—a movie in which large areas of a model Los Angeles were devastated—included commercially available model railroad landscaping. But the detailing of such models goes beyond even the most demanding hobbyist's requirements. For *1941*, master modelmaker Greg Jein printed up tiny magazines and newspapers from World War II, inserting them into newsstands and crumpling them to use as trash, along with tiny crushed Coke cans. Many of the buildings along his

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In *Caveman*, animator Peter Kleinow integrated stop-motion "action" of the model horned lizard with live-action background plates, rear-projected one frame at a time.

miniature Ocean Park and Hollywood Boulevard had decorated rooms, merchandise displays, and coats on the walls. And, of course, model detailing includes careful "aging" with judicious applications of paint and dirt.

Poetry in Motion

Realistic photography of such models has come a long way since the hilariously clumsy spaceships of the original *Flash Gordon* and the obvious models in the long string of Japanese monster movies during the 1950s and 1960s. Optical fibers inserted into buildings and spaceships carry concentrated light to produce realistic-looking, brightly lit windows; high-speed photography enables small explosions to be replayed so that demolished models in battle sequences are given a large-scale appearance; atmospheric haze is simulated using diesel-fuel aerosols sprayed about during filming.

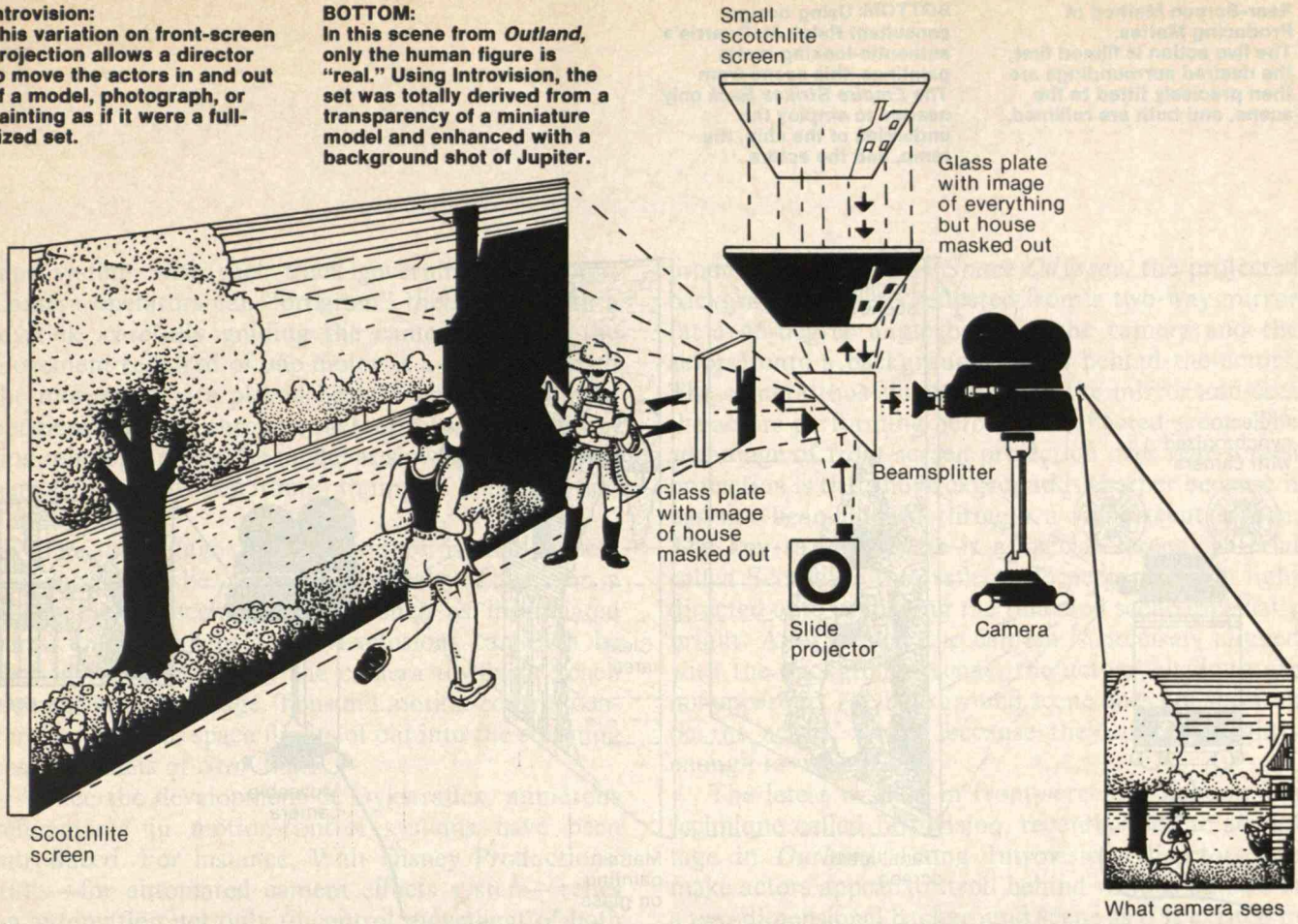
To bring models such as monsters to life, the traditional technique of "stop-motion" photography, first used effectively by Willis O'Brien in 1914, is still employed (O'Brien is perhaps best known for his stunning animation in *King Kong*). A recent excellent example of stop-motion photography is the sequence in *The Empire Strikes Back* in which the heroic rebel forces are menaced by gigantic walking tanks that clomp across the snow-covered landscape with ponderous realism. Actually, they were all miniatures, photographed a frame at a time against painted backgrounds that rested on snow made of baking soda. After each frame, up would pop a technician through a trap door in the scene to move the walker a tiny amount, based on film the group had taken of an elephant's stride. Similarly, the convincing footage in *Empire* of Luke Skywalker's camellike alien mount (called a "tauntaun") striding across the surface of the ice planet involved stop-motion photography.

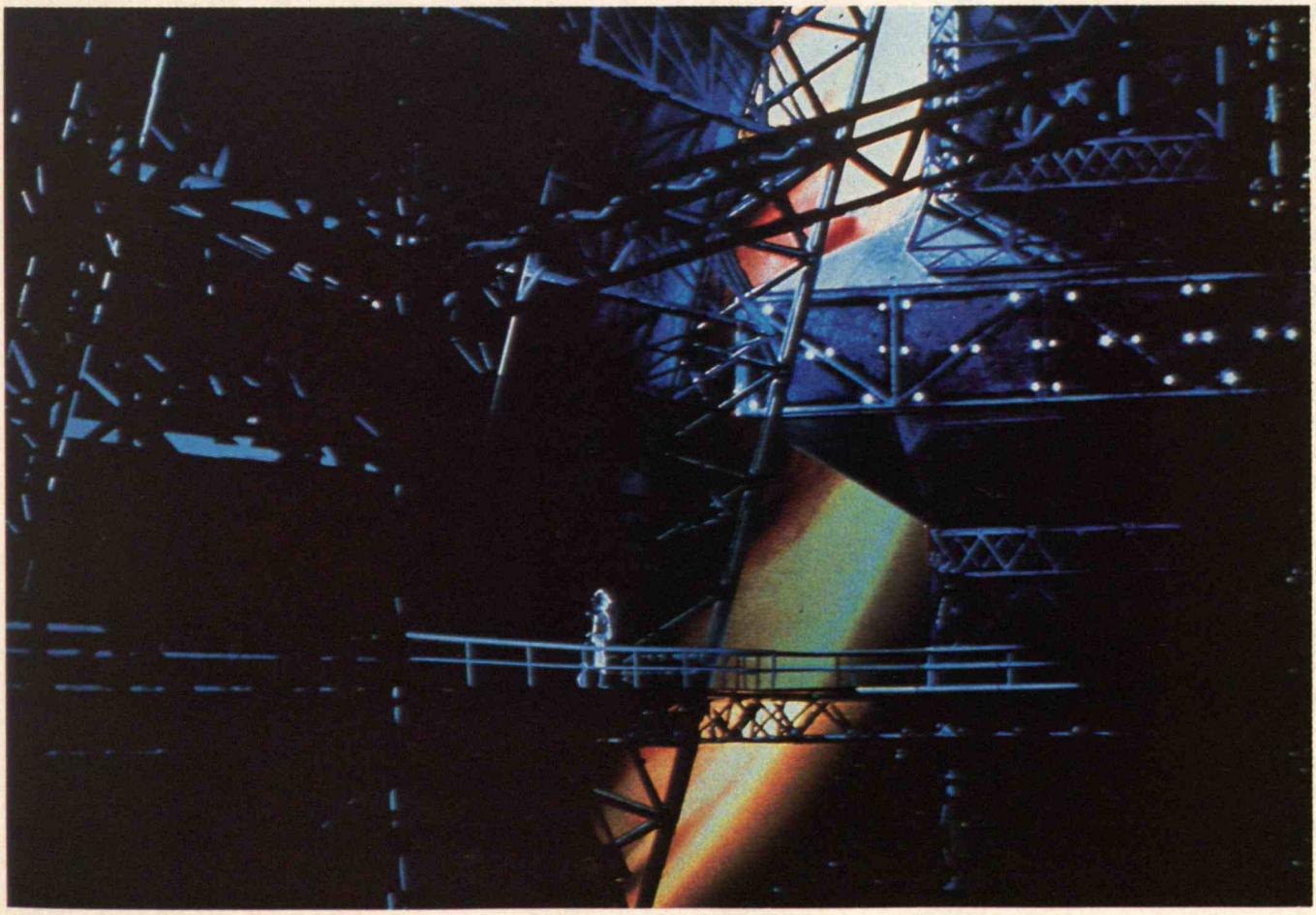
However, the most significant advance in model photography has been in "motion-control" technology, first developed by Alvar Miller for effects supervisor John Dykstra in *Star Wars*. Before the "Dykstraflex" motion-control system was introduced, models such as spaceships were photographed while rigidly mounted or hanging from thin wires, with "eyeballed" camera movements supplying the illusion of motion. While careful photography could produce remarkable results, as in the spaceship sequences of *2001*, traditional techniques seriously hindered the illusion of model movement. Stop-motion photography could be used to portray aerial acrobatics, but the images would have none of the blur necessary to portray fast motion realistically.

The heart of the Dykstraflex system is a motorized camera mount that gives the camera pan, tilt, roll, yaw, and the capability of horizontal travel. The precision motors are controlled by a multitrack magnetic

Introvision:
This variation on front-screen projection allows a director to move the actors in and out of a model, photograph, or painting as if it were a full-sized set.

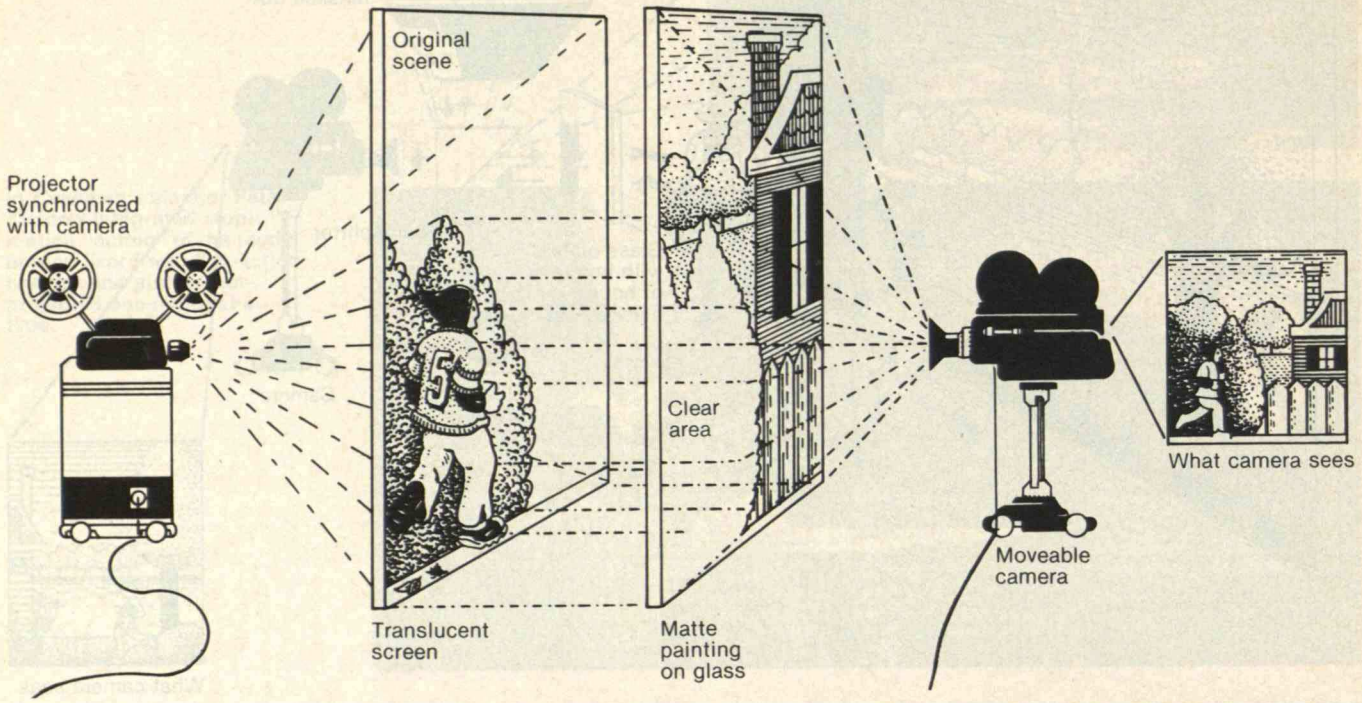
BOTTOM:
In this scene from *Outland*, only the human figure is "real." Using Introvision, the set was totally derived from a transparency of a miniature model and enhanced with a background shot of Jupiter.

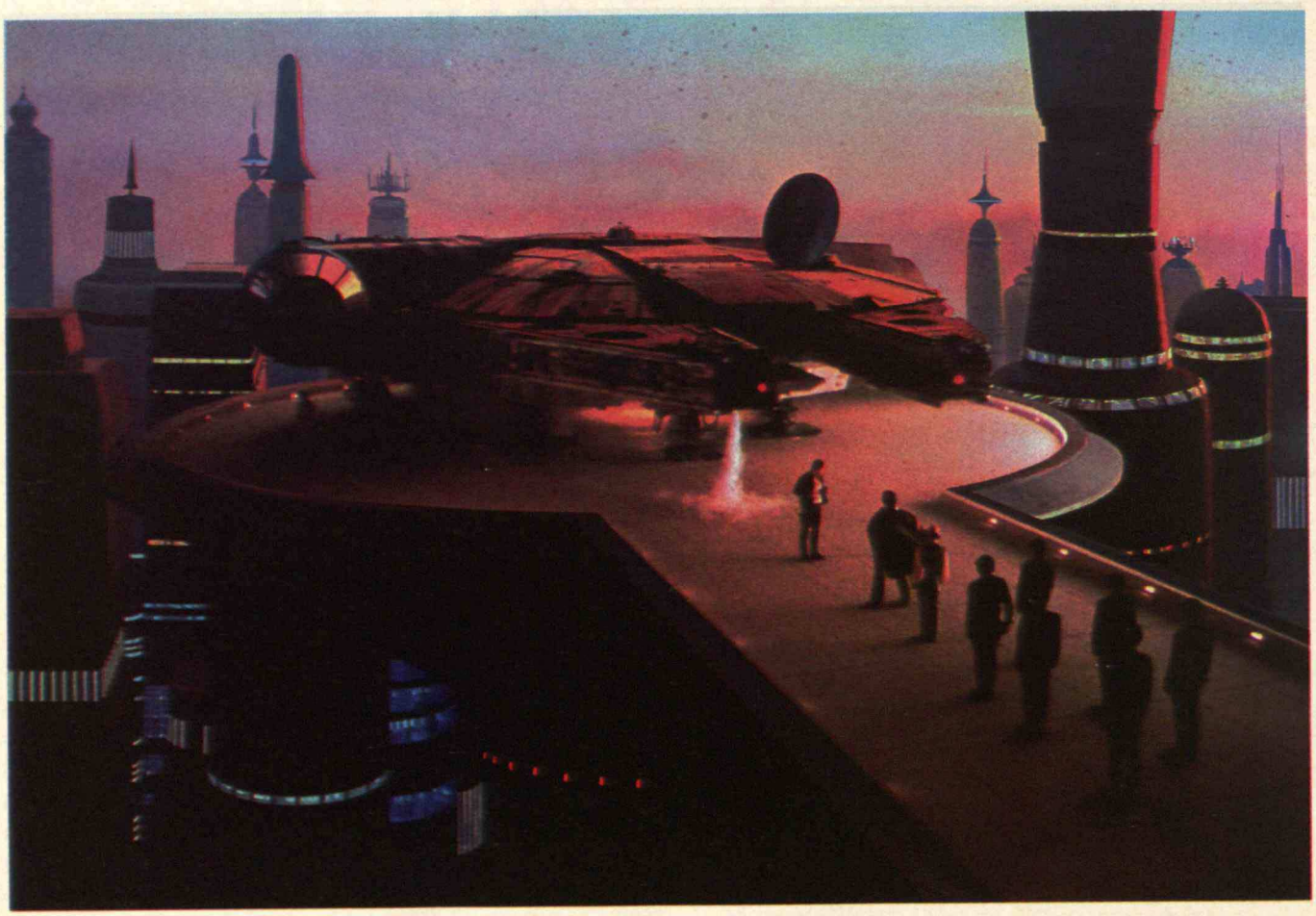




Rear-Screen Method of Producing Mattes:
The live action is filmed first, the desired surroundings are then precisely fitted to the scene, and both are refilmed.

BOTTOM: Using design consultant Ralph McQuarrie's authentic-looking matte paintings, this scene from *The Empire Strikes Back* only needed to employ the underside of the ship, the ramp, and the actors.





tape system, with each track governing one motor. Camera operators can "program" their shots with a joystick, carefully guiding the camera through the movement required of one motor at a time. When all the movements are played back at once, the camera obediently moves through the entire prescribed motion, photographing the model at slow speeds (of perhaps two seconds per frame) to impart both blur and depth of field.

The advantage of Dykstraflex is that whole sequences can be repeated precisely. Thus, for a science-fiction scene, elements such as illuminated parts, engine exhausts, and explosions can each be shot in repeat passes of the camera to "burn" each element into the image. Thus did motion-control convert the staccato space flights of old into the stunning cosmic ballets of *Star Wars*.

Since the development of Dykstraflex, numerous refinements in motion-control systems have been introduced. For instance, Walt Disney Productions' ACES—for automated camera effects system—relies on automation not only to control movement of both camera and model but also to calculate the "flight path" itself. With ACES, the operator need only tell the computer what points in space the camera and model should pass through; the system then generates a precisely repeatable movement through those points, including changes in focus and speed.

Going to the Matte

The business of integrating live actors, background scenery, models, matte paintings, and other visuals into a film still relies mainly on technologies in use for decades, although there have been some important recent developments.

In the simplest case, the director merely wishes to create the impression that actors in a studio are performing either outdoors or before a seemingly life-sized set that is in fact a miniature. This is usually accomplished with the techniques of front-screen or rear-screen projection. In the latter case, the background scene is simply filmed beforehand and projected onto the rear of a translucent screen placed behind the actors. Many interior automobile shots use rear-screen projection to portray the scenery outside the car, and legions of citizens have appeared to be fleeing from gigantic monsters photographed beforehand (using stop-motion animation) and then projected behind them.

In front-screen projection, first used in a major production in *2001: A Space Odyssey*, the projected background scene is reflected from a two-way mirror (at a 45-degree angle between the camera and the actors) onto a background screen behind the actors. The camera thus shoots through the mirror and sees the actors performing before the reflected scene. The advantage of front-screen projection over rear-screen projection is that the background is sharper because it has not been filtered through a translucent screen. The key to its success is a special screen material called Scotchlite that reflects 95 percent of the light directed onto it, making the reflected scene especially bright. And because the camera is precisely aligned with the background scene, the actors' shadows are not apparent. The background scene does not show up on the actors' bodies because they are lit brightly enough to wash it out.

The latest wrinkle in front-screen projection is a technique called Introvision, recently used to advantage in *Outland*. Using Introvision, directors can make actors appear to stroll behind various objects in a two-dimensional background scene as if it existed in three dimensions. Introvision entails the simultaneous use of two superimposed images of the background—one projected onto a rear screen, the other onto a side screen—with both reflected back to the camera so that it sees only one scene.

In *Outland*, for example, one sequence might call for hero Sean Connery to walk behind a transformer. The Introvision technicians would simply place a pane of glass between the camera and the larger front screen, using tape and paint to "matte out" (or mask) the image of the transformer. Then, on a second pane of glass between the camera and the smaller side screen, the technicians would matte out everything *but* the image of the transformer. The composite "background" that the camera sees allows Connery to walk into the area and seem to momentarily disappear "behind" the transformer.

Introvision was used on an even larger scale in *Outland* to place the actors amidst what seemed to be an immense ore-refining plant—resembling a giant Erector set—on the Jovian moon Io. Actually, this huge structure was a set of intricate models photographed close up to produce the backgrounds. By merely placing the actors on crude platforms to elevate them to the correct height, and installing ramps, railings, and other objects that the actors actually had to touch, the illusion that they were actually inside an enormous structure was created. As a result, the movie was able to portray actors seemingly interacting

Realistic photography of models has come a long way since the hilariously clumsy spaceships of *Flash Gordon*; the most significant advance has been in "motion-control" technology.

with sets that would have cost millions of dollars to build (if indeed they would have been possible at all).

Optical Solutions

While front-screen and rear-screen projection work well when only a limited area of background is to be shown, long shots would require immense background screens. And often a film director wishes to alter a portion of some panoramic scene—to show the skyline of an ancient city, for example. In such cases, effects technicians must resort to image-combination tricks performed not in the studio but in an optical laboratory.

In the simplest case of image combination, the director wants to combine two pieces of live action—say, an actor having a two-sided conversation with himself. To produce this illusion, one side of the scene is masked with a piece of black cardboard and the actor is filmed. The film is then rewound and the actor moves to the other side of the scene. He is then refilmed with the first side masked to protect the first exposure.

However, most modern image-combination tricks are far more involved. For instance, one popular technique for inserting actors, spaceships, or other objects into large-scale background scenes is the "blue-screen" method—so named because the actor actually performs before a precisely colored blue screen, with the background scene filmed separately. Using complex film printing techniques that take advantage of the color differences between the actor and the blue background, film technicians can manipulate the actor's image. They can create an unexposed "hole" in the background scene, called a "traveling matte" because it is precisely contoured to actors' images and changes from frame to frame as they move. Into this hole, they jigsaw the actors' images by combining films in an optical printer (to be explained later). Thus, when Superman zips over Metropolis, he is actually suspended before a blue screen; a camera crew in a helicopter does most of the work.

In many effects shots, technicians are asked merely to add static background to a scene in which the live action occurs within a defined portion of the film frame. In such cases, they use the popular optical trick of superimposing matte paintings to "build" backgrounds that would be far too expensive to produce in real life. In one method, after a piece of film is shot, matte painters project it on a rear-projection screen, inserting a pane of glass before the screen. They can carefully execute the matte painting on the glass, leaving clear the portions where the live action is taking place. Next they simply refilm the rear-projected scene with the matte painting in place. This system suffers from the usual fuzziness problems of rear-screen projection, but it allows the camera to move about during matte filming (an option not possible with front-screen projection). When special-effects artists are willing to live with a stationary camera, they use a similar front-screen projection technique of matte painting, for they can achieve sharper, brighter images than with rear-screen projection.

A sophisticated matte printing technique developed by Douglas Trumbull and his associates marries matte paintings to live action with a device called an optical printer. First developed in the 1930s, the optical printer remains perhaps the most important tool in the special-effects industry. It consists basically of a movie projector face-to-face with a camera, and interlocked so that the camera can photograph film, frame-by-frame, run through the projector. If two films are run together (in "bipack"), the camera will superimpose them and produce a third negative. A variety of camera tricks, such as fades and dissolves, can be produced by adjusting the two images.

Trumbull's method involves first filming the live scene with the camera rigidly mounted. This film is then projected and a black matte is produced that masks the scene's background. The matte itself is then filmed and run in bipack with the original scene through an optical printer. This produces a third piece of film in which the matte area is unexposed. A matte painting—the illusory, large-scale background—is then produced on masonite and filmed. When these two films are combined, again using an optical printer, the desired effect is achieved.

Until recently, in shots to be matted later, the camera had to remain stationary during live-action filming so that the separate elements could later be precisely superimposed frame-by-frame. But Walt Disney Productions has now developed a computer-controlled system called Matte-Scan, first used in *The Black Hole*, that permits the integration of matte paintings with scenes in which the camera is moving. This increases the believability of matte paintings enormously, for the camera can now freely pan and tilt and dolly about a scene involving both live sets and paintings, with no hint of which is which. Basically, Matte-Scan employs the technology of ACES to record the movement of the camera during live-action film-

The next age of special effects will draw on computer-aided design, image enhancement, and techniques used in aircraft flight simulators.

ing of a scene and to later precisely repeat that motion when filming the complementary artwork. Disney technicians plan to extend the technique in future productions by superimposing whole series of matte paintings in multiplane exposures, thereby creating illusions of depth.

Computers in Tinseltown

Special-effects artists have been able to pull off some truly remarkable visual stunts using these techniques, but the next age of special effects will be even wilder. Drawing on computer-aided design, image enhancement, and technologies used in aircraft flight simulators, engineers are now applying computers to the film industry. So far, computer-generated images have shown up mainly as spaceship instrument displays in sci-fi epics. But it won't be long before more powerful computers, programs, and higher-resolution graphics systems achieve star status on the movie screen. A modest sample of what is possible can already be seen on television: low-resolution computer graphics are enhancing commercials with an ease and a dazzle that are the envy of the film industry. And actors are inserted into miniatures and other backgrounds with the mere flick of a programmer's wrist.

Basically, computer graphics is being used in two ways by filmmakers: to scan and manipulate filmed images (replacing devices such as optical printers) and to generate artificial images. In image generation, Information International, Inc. of Los Angeles has produced three-dimensional computer pictures of spaceships that are virtually indistinguishable from models, even down to glimmering reflections off cockpits and stains on the fuselages. Company engineers have also experimented with computerized scenery and even a computerized actor. Called Adam Powers, he was produced from a computer data base generated by scanning films of a live actor. Adam, who resembles a plastic doll cavorting on the screen, can remove his head, turn himself inside out, become transparent, and do similar tricks that no ordinary human actor would care to attempt.

Other groups have experimented with computer animation, in which the computer is given two positions for a character and asked to fill in the movement between. The most sophisticated animation programs have been developed at the New York Institute of Technology (NYIT), where the first commercial feature film done entirely by computer animation, *The Works*, is now being prepared. NYIT's version of animation improves substantially upon the stick-figure drawings of conventional computer graphics—their animated characters have a realistic "gloss," three-dimensionality, and complexity of movement.

Computer graphics as a special-effects technique is not without problems—at present, resolution is low and cost is high—but it will eventually be an important tool for the film industry. While computer graphics will probably never take the place of realistic scenery, actors, and models, its clever use will allow a totally new range of options. Moviegoers will soon get a taste of such possibilities in the upcoming Disney science-fantasy *Tron*, in which computers will be used extensively to generate fantastic vistas of texture and light.

The other major use of computers in film—to manipulate images—may have a more profound influence. As we have already seen, combining filmed images is no simple task. Several companies are currently developing electronic compositors that can scan film, digitize the information, and manipulate it according to programmed instructions. Such compositors could easily produce dissolves and other camera tricks, integrate matte paintings, color-correct film, enhance it, and even clean up graininess and scratches. Some special-effects artists even foresee the day when the artificially intelligent compositor will recognize objects in a scene and manipulate their images individually. One actor could be replaced with another; objects could be altered, enhanced, or eliminated at a director's whim.

Special-effects techniques have enormously expanded the range of images with which Hollywood's dream merchants can charm us, and there's obviously more to come, but far more important are the imaginative minds behind the methods. While spaceships, monsters, and shoot-'em-up plots are great fun, these only begin to tap the full artistic and intellectual potential of modern film technologies.

Dennis Meredith is news bureau director for the California Institute of Technology and former managing editor of *Technology Review*. In addition to numerous magazine articles on science and technology, he has written books on fatherhood and the Loch Ness monster.

Further Reading

Cinefex, a quarterly devoted to special effects. P.O. Box 20027, Riverside, CA 92516. Back issues available.

Cinefantastique, a quarterly devoted to science and fantasy films. P.O. Box 270, Oak Park, IL 60303. Back issues and books on special effects also available.

Schechter, Harold, and David Everitt, *Film Tricks*. New York: Harlan Quist Books, 1980.

Last Valentine's Day Mary had a hole in her heart.

Mary is just one of 25,000 children born each year with heart defects, but open heart surgery has corrected the problem. And this Valentine's Day, for the first time in her life, she's going to be a normal kid.

The American Heart Association is fighting to reduce early death and disability from heart disease and stroke with research, professional and public education, and community service programs.

But more needs to be done.

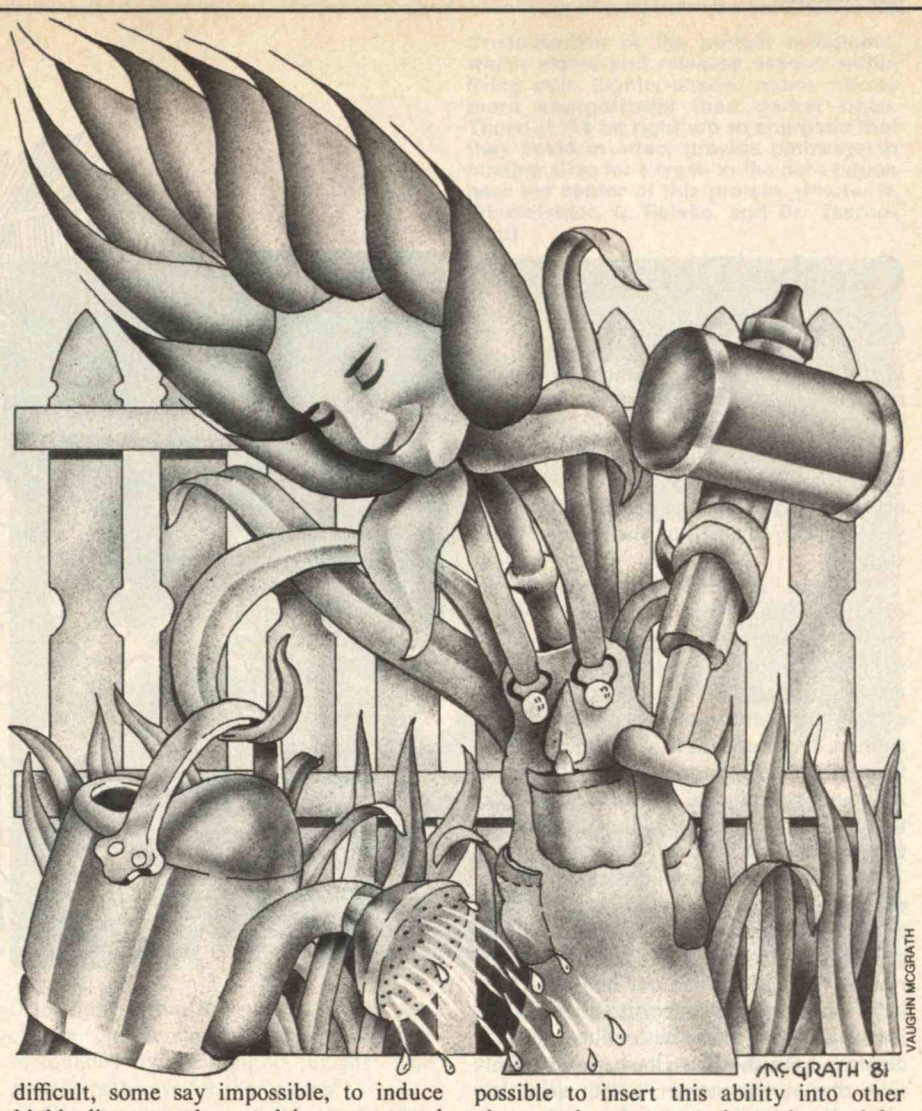
You can help by making this Valentine's Day "A Time To Remember." Send the Mary in your life a special occasion card from the American Heart Association, listed in your telephone directory.

American Heart Association

WE'RE FIGHTING FOR YOUR LIFE

Res Naturae

New Genes for Old Beans



The Green Revolution of the mid-1960s produced more casualties than heroes. Twenty years of research brought us cereals so hardy and fertile that corn, rice, and wheat production skyrocketed. But it soon became evident that the highly bred plants were too finicky to provide any real solution to world food problems—the plants require quantities of fertilizer, pesticides, and machinery that are beyond the budget of most Third World farmers.

The "second" Green Revolution should, some experts claim, reverse the disappointing outcome of the first. Using techniques developed over the last decade, scientists plan to introduce plants that are not only better suited to endure and thrive in our changing environment, but are so independent that they eventually might even produce their own fertilizer.

"The new Green Revolution will be the opposite of the first one," predicts Frederick Ausubel, associate professor of biology at Harvard University. "High technology will no longer be required to grow plants. Instead, we're using technology to make them more self-suffucient."

The techniques that prompted the prediction of this new wave of plant breeding are tissue or cell culture and recombinant DNA. The first method is really a generic term describing the growth of a whole, intact plant from part of a parent plant—including individual cells—in medium. The second, commonly known as gene splicing, entails the actual transfer of genetic material.

The most promising tissue-culture approaches are protoplast fusion and the propagation of whole plants from specially selected mutated cells. In protoplast fusion, two plant "genomes" (entire genetic endowments) are merged to form a single nucleus. Completely novel plants have been engineered in this manner, perhaps the most picturesque of which is the "pomato," an inedible fusion of tomato and potato that looks like neither of its parents. To propagate plants from single cells, scientists screen cells for certain characteristics, select those with the desired traits, then grow the cell into a plant whose structure is further controlled by the medium in which the original cell is cultured.

However, while promising, neither method is yet particularly practical. It's difficult, some say impossible, to induce highly divergent plant nuclei to merge, and when related species combine, the results can be more novel than edible. The pomato plant, for instance, bore neither potato nor tomato. The coaxing of individual cells into whole plants can be even more frustrating—some plants, like soybeans, simply refuse to cooperate. Also, finding cells with desirable characteristics such as resistance to drought or toxins is not easy; billions of cells must be screened for the traits, often without success. Experiments have resulted in the cultivation of some economically important varieties of potato, but so far cereals and most other plants have eluded scientists' control.

Recombinant DNA technology, experts say, offers this control, by allowing the direct alteration of the plant's genetic makeup to suit human needs. For example, the protein quality of cereals could be increased, or their pest resistance enhanced.

But perhaps the most exciting potential agricultural application would be the transfer of nitrogen-fixing genes into plants that normally lack them. Nitrogen-fixing plants such as legumes convert atmospheric nitrogen into nutrient compounds, essentially producing their own fertilizer. If it became possible to insert this ability into other plants such as corn or wheat, the need for chemical fertilizers would be sharply reduced.

So far, however, no sure and effective way has been found to inject desired characteristics directly into plant genomes. A bacterial carrier has been used to transfer bits of one plant's DNA into the cells of another, but current methods produce a tumor as well as a genetically modified plant. Still, genes carried by agribacteria are finding their way into the plant's nucleus, and while scientists still don't know exactly where they go or what their exact effect will be, researchers nonetheless insist they have made a very important first step.

"Plants manufactured in this manner might be harder to come by," says Ausubel, "but they will ultimately require less pesticide, less fertilizer, and will not have the negative social imact of plants developed during the first Green Revolution. Of course, this is a relatively new thing, and we have a long way to go, but by the year 2000 there will be a $50 to $100 billion market for genetically engineered plants, and some real motivation to cash in on the processes we're developing now."—*E.R.S.* □

On the Demise of Dinosaurs

YANI BATTEAU

Earth scientists have recently suggested that a single great catastrophe 65 million years ago destroyed the dinosaurs and roughly half of all species then in existence. Evidence indicates that the episode took place over a period of no more than 100,000 years—a mere instant on the geologic time scale.

At first, scientists proposed that an extraterrestrial event was somehow to blame—perhaps the impact of an enormous meteorite, a comet, or debris from a nearby supernova. Such a hypothesis would explain why certain elements, particularly iridium, are abundant in sedimentary rocks formed around the time of the extinctions. Although common in certain kinds of meteorites, iridium is normally very rare in the earth's crust.

But other clues rendered that cosmic explanation vexingly inadequate. The cataclysm wreaked far more damage on life in the oceans than on land. Even more curiously, it nearly wiped out marine organisms with calcium carbonate shells while hardly affecting those with silica shells. It destroyed the dinosaurs but spared primitive, diminutive mammals that soon became the dominant higher form of terrestrial life.

Now a new scenario that seems to explain all the clues has been devised by a group of researchers at M.I.T.: John Lewis, professor of earth and planetary science, Ronald Prinn, associate professor of meteorology and physical oceanography, and graduate students Hampton Watkins and Hyman Hartman.

A comet (basically a muddy snowball about 10 kilometers across) enters the earth's atmosphere traveling at perhaps 60 times the speed of sound. As it streaks through the atmosphere, it creates a powerful shock wave, which transfers energy from it to the air. The air as far as 300 kilometers from the comet is heated to several thousand degrees Celsius.

The shock heating generates chemical compounds rare in the atmosphere under normal conditions, including nitric oxide, which oxidizes to nitrogen dioxide. The nitrogen dioxide reacts with water in the atmosphere to form nitrous acid and eventually falls to earth as "acid rain." Though weakly acidic, this substance is quite toxic to living organisms (Watkins compares it to sodium nitrite, which prevents decay in foods by poisoning bacteria).

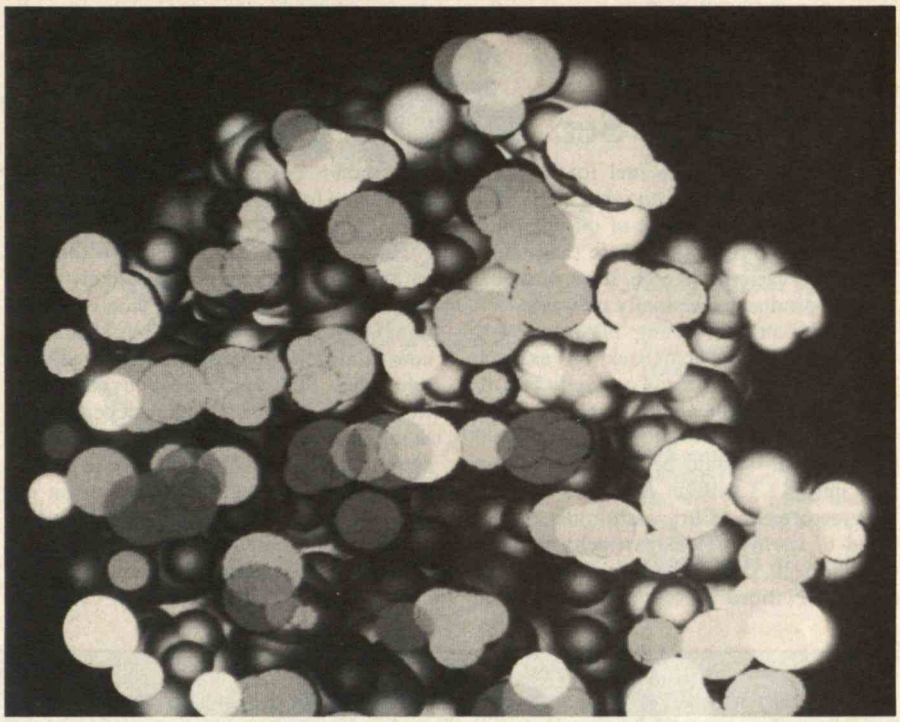
The two researchers calculate that about 1 billion molecules of nitric oxide would be created for each erg of energy that passed from comet to atmosphere. A typical such event would release about 10^{31} ergs, equivalent to about 250 million megatons of high explosives.

The comet would be likely to land in the ocean (since oceans comprise two-thirds of the earth's surface). A spectacular explosion would be generated as the comet struck and released its prodigious energy, completely vaporizing itself and a substantial volume of seawater. Superheated seawater, mineral salts (including elements such as sodium, calcium, magnesium, sulfur, chlorine, and others), and part of the vaporized comet would be blown high into the atmosphere.

The researchers say that the vaporized calcium and magnesium would condense rapidly and fall relatively harmlessly back to earth. Left behind, the uncondensed chlorine and sulfur would form hydrochloric acid and sulfur dioxide—"like something you'd get out of the flue at a coal-burning plant," says Watkins.

The virulent acid rain that would ensue would be deadly to life on land and in the sea. On land it would defoliate trees and other plants over an enormous area, says Professor Lewis. Although the effects would last only a few years, "anything that eats leaves"—such as plant-eating dinosaurs, which may also have served as food for their carnivorous counterparts—would have been at great risk, he says. He suspects that primitive mammals survived by hoarding and eating seeds and nuts. In the oceans the acid rain would dissolve the carbonate shells of many marine organisms and kill microorganisms near the ocean surface. But silicate shells would be able to withstand the action of the acid. With the base of the food chain severely damaged, higher animals such as plankton-eating fish, larger carnivorous fish, and other predators would starve.

Such an impact from a comet or asteroid might occur about once every hundred million years, but the researchers do not discount the possibility of a number of impacts occurring in a relatively short period. Watkins points out that modern technology has provided a novel way to trigger a similar deluge of acid rain—from the many "small" explosions of a nuclear war, which would heat the atmosphere even more efficiently than a single comet.—*Lynn Hall* □



Cross-section of the protein myoglobin, which stores and releases oxygen within living cells. Lighter-shaded atoms vibrate more energetically than darker ones. Those at the far right are so energetic that they could in effect provide pathways to binding sites for oxygen in the dark region near the center of this protein. (Photo: H. Frauenfelder, G. Petsko, and Dr. Tsernoglou)

Fundamentals

Flexible Proteins

Because proteins are vital to life, scientists have long sought to understand how they function. Not only do proteins comprise the very structure of living tissue, they are also involved in the digestion of food, the distribution and use of nutrients within living things, the reactions of organisms to environmental stimuli, and their fight against disease.

Until recently the search for this understanding met with limited success, but a new research direction is providing some answers to the question of how proteins keep organisms alive. Traditional research focused almost exclusively on the chemistry of these complex molecules; one current approach points to physical movements within protein molecules as the key to how they work.

The term "protein" is derived from the Latin "proteus," meaning "of the first importance." However, Proteus was also the name of a Roman god who changed shape according to circumstances, a metaphoric coincidence that suggests part of the means by which proteins go about their business.

A few years ago only a handful of papers had ever been published on protein motion. Last year the CIBA Foundation, the British research organization, selected motions in proteins as the topic of its prestigious annual conference. Researchers at M.I.T. and the University of Illinois have more recently made some additional findings.

One kind of protein movement is the vibrations of individual constituent atoms. Using x-ray crystallography, Hans Frauenfelder, professor of physics at the University of Illinois, and Dagmar Ponzi, lecturer in chemistry at M.I.T., have detected such motion in myoglobin, a large globular protein that stores and releases oxygen within cells (in contrast, hemoglobin transports oxygen). Their research solves the long-standing mystery of how oxygen binds onto myoglobin at a site buried within the protein.

Explains Ponzi: "The vibrations are random, but there is a probability that some of the atomic motions couple with each other and open a channel for oxygen." Each of the 3,200 or so atoms in the protein vibrate about 1 trillion times per second, but Professors Frauenfelder and Gregory A. Petsko, who heads the M.I.T. research group, have determined that atoms on the surface of myoglobin vibrate more energetically than those within the protein. Their conclusion: the protein may have a dense core surrounded by "semiliquid regions" that provide pathways for the oxygen.

Concerted motions of groups of atoms in some proteins—entire segments of structure—comprise the second type of protein movement. Such motions are characteristic of some proteins that act to spur chemical reactions. This kind of protein, called an enzyme, provides an ideal environment for a particular chemical reaction, and may thus speed a reaction by over a billionfold.

Tom Alber of the M.I.T. research group is investigating such movement in an enzyme called triose phosphate isomerase, which helps break down sugars. During catalysis, a usually flexible loop in the enzyme structure folds over on itself and becomes nearly rigid. He speculates that the resulting entropy changes (changes in orderliness) of the enzyme somehow help speed the reaction.

Concerted movement of the parts of other proteins apparently send biochemical "signals" that can trigger chains of vital chemical reactions. This mechanism can explain how the bacterium *Salmonella typhymurium* "searches out" and feeds on sugars in a seemingly intelligent way. A sugar-binding protein in the bacterium has been found by Sherry Mowbray of the M.I.T. group to move characteristically during the binding process. When one of a cluster of sugar molecules binds with the protein, the tail of the bacterium—which normally moves randomly—suddenly moves purposefully, propelling the bacterium toward the sugar cluster. The act of binding triggers development of a rudimentary sort of "nervous system" within the bacterium, says Mowbray. She explains: "The protein seems to have two lobes connected by a narrow 'hinge.' The sugar binds near the center of the hinge and, we think, causes the hinge to bend. This major change in conformation seems to start the chain of chemical events that transmits a 'signal' to the tail."

In another example of concerted motion, the protein calmodulin is able to change its selectivity for numerous reaction targets in a way not yet understood. Says Barbara Seaton, another M.I.T. researcher, under different environmental conditions, small variations in the protein's concerted motions cause it to "prefer" one target over others.

The goal of this new field of research is no less than "a unified theory of how proteins work," says Professor Petsko. He notes that such an achievement would be of immense use in understanding the biochemical basis of disease and designing effective drugs, in understanding—and utilizing—catalysis more effectively, and even in "engineering" genes.—*Allison L. Casey*

Transportation

Coal Future for Ships at Sea

Oil replaced coal as a fuel for merchant ships some 50 years ago, and with ample reason: the heating value of oil per pound and per cubic foot is far more than that of coal; oil is easier to handle, store, and burn; and oil produces essentially no waste.

But because of rising oil prices, coal seems poised for a comeback. For example, with oil at $200 a ton and coal only $50, the annual fuel bill of a ship that uses 30,000 tons of oil a year—equivalent to 48,000 tons of coal—would be $6 million for oil but only $2.4 million for coal. Professor Chryssostomos Chryssostomidis, acting head of the M.I.T. Department of Ocean Engineering, thinks these calculations support the National Research Council's Maritime Transportation Research Board's prediction of a new era of coal at sea. "By the turn of the century," he says, "a substantial portion of the world's merchant ships may again be coal-fired." Already one new coal-fired bulk carrier is under construction at General Dynamics in Quincy, Mass., for New England Electric Systems.

However, Professor Chryssostomidis' enthusiastic prediction is not likely to be fulfilled on the basis of new ship construction. Only a few of today's merchant ships, now almost wholly diesel-powered, are scheduled for replacement by 1999. If world trade is to become less dependent on the whims of oil suppliers, the propulsion systems of today's ships will have to be converted from diesel to coal-fired steam engines. (World shipping now consumes nearly 4 billion barrels of oil a year, about 7 percent of total world oil demand.)

No problem, says Professor Chryssostomidis. He is confident that high-speed pneumatic coal-handling systems and fluidized-bed boilers can be perfected quickly and that, with the necessary infrastructure in place, the conversion of a ship could be accomplished in less than three months, and perhaps as quickly as 30 days. Conversion to coal is practical for container ships of all sizes, because much of their cargo is carried above deck. But conversion is not likely to be economical for bulk carriers of less than 70,000 tons, he says. The coal-handling and storage facilities would take up too much cargo space.

The cost of equipping a 20,000-ton container ship with a new boiler, stokers, bunkers, and appropriate coal-handling equipment would be about $10 million, which owners would recoup through reduced fuel costs in less than four years. And within a decade, Professor Chryssostomidis says, a new method of conversion may reduce associated costs significantly: simply cut a

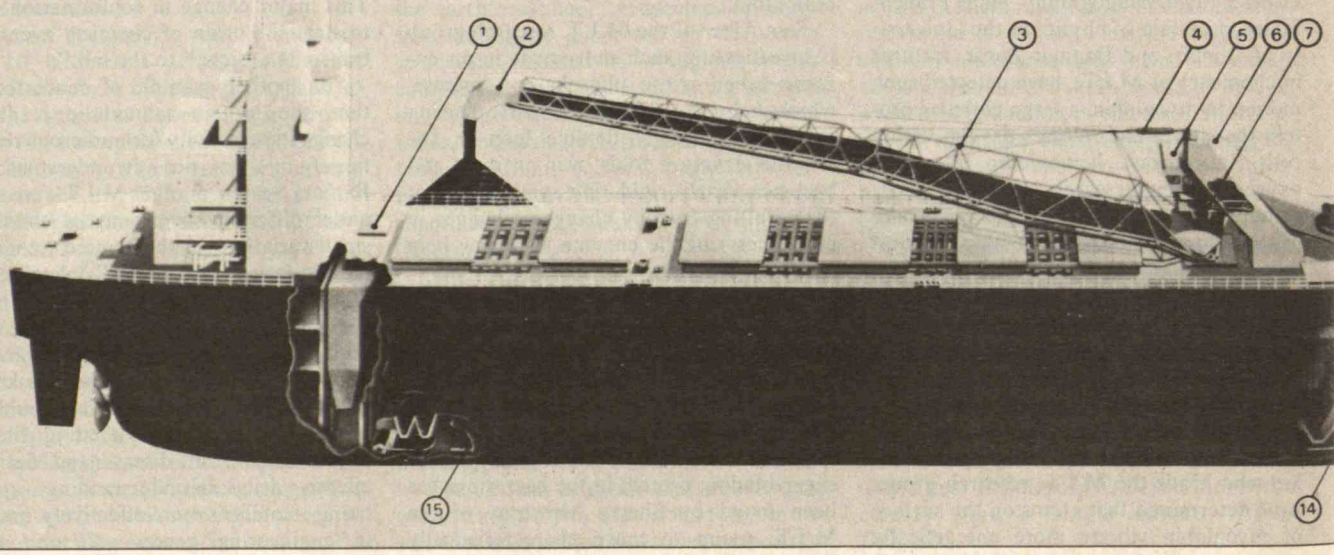
A Coal Steamer for the 1990s

By any measure an impressive vessel, the collier CV-2000 (yet to be christened) is the first revival of a once-common breed: the coal-fired steamship.

At 655 feet overall, she will carry 36,000 tons of coal. The cost will be $600 million, a sizable venture for New England Electric System, the owner, and General Dynamics, the builder. One large coal-fired boiler (it can also burn oil for operation in port; the ship carries 5,000 gallons of bunker fuel for the purpose) will provide steam to the ship's 12,000-shaft-horsepower turbine and gear unit. At top speed, 15.7 knots, its single propeller will revolve 115 times per minute. Bow and stern "thrusters"—controllable-pitch propellers set in tunnels running athwartship—facilitate maneuvering in port.

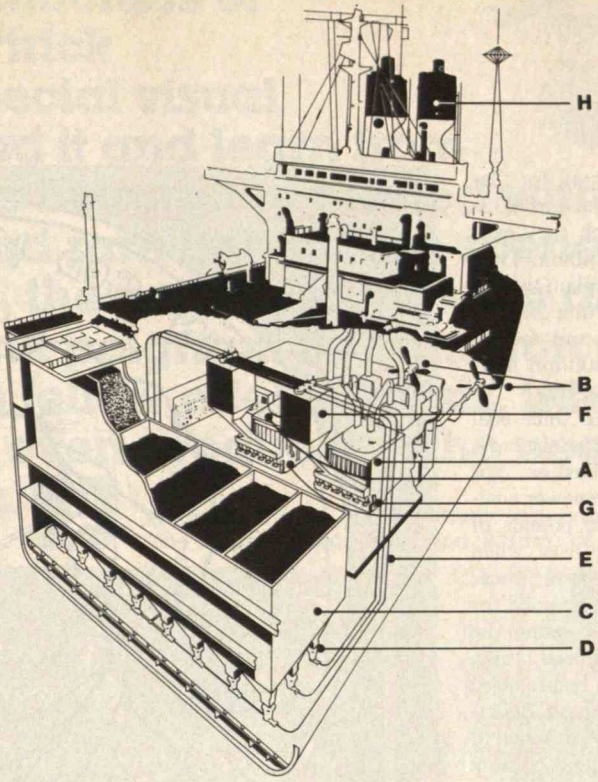
While the ship could be characterized as a benchmark test for the economics of coal propulsion in a period of escalating oil prices, to the utility it is simply a workhorse. The vessel is an integral part of a 15-year "strategy for coal supply and transportation."

New England Electric's conversion of the Brayton Point Station in Somerset, Mass. from oil to coal (at a cost of $180 million) was the first move to implement that long-range strategy. With



ship open, remove the oil-fired power plant and bunkers, and insert a prefabricated section containing a new coal-fired power plant and the supporting equipment.

A high-technology alternative proposed by John Powell of Scripps Institution of Oceanography and Thomas Botts and James Powell of Brookhaven National Laboratory: substitute a coal-fired turbine (instead of a boiler) for the diesels in today's cargo ships. Such a plant would be much smaller and lighter than the diesel of equivalent capacity. They told the Intersociety Energy Conversion Engineering Conference in Boston last fall that these savings would compensate for the extra weight and volume that coal entails. Only one technological uncertainty here: a laser fragmentation scheme still on the drawing board would be needed to reduce the size of particulates traveling from the coal combustor to the turbine, thus protecting the turbine blades from erosion. The researchers suggest also possibilities). Modern technology and new legislation will make the rapid turnaround possible:



Coal-handling system proposed for coal-fired ships of the near future. The two boilers (A) of a twin-screw (B) ship would derive their coal fuel from the five-section aft coal storage bunkers (C). Coal transfer pumps (D) beneath the bunker would convey the coal through piping (E) to the receiving bins (F). After being crushed by a mechanism in the bottom of the bins, the coal would be mechanically fed into the furnaces (G). Each furnace is serviced by its own exhaust stack (H); ash would be continually pumped from the furnace in a water slurry and exhausted from the side of the ship. *(Drawing by Michael G. Cobb)*

conversion completed, the generating station will consume approximately 3 million tons of coal per year (compared with 12 million barrels of oil)—about 2.2 million tons of which will be delivered by the CV-2000.

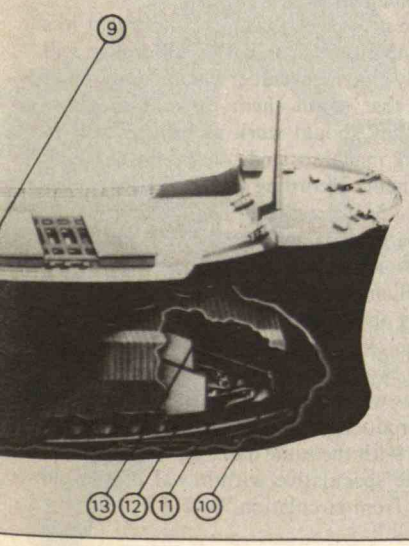
Following launch early next year from the Quincy shipyard of General Dynamics, the CV-2000 will begin six-day round trips between Brayton Point and coast ports in Virginia, Maryland, and Pennsylvania (alternate cargoes of gypsum, aragonite, and iron ore pellets

☐ The ship will automatically empty its own hold with a gravity-fed system of conveyer belts, hydraulically operated gates, and a massive articulated boom. The whole job will take only about 10 hours.

☐ Recent federal law gives domestic coal-carrying ships priority loading rights at coal terminals. Says Guy W. Nichols, president of New England Electric: "This legislation is expected to save up to 30 days and $500,000 each trip. Without these savings, the project would not be economical."

On the basis of dollars per ton of coal transported, the ship will actually operate at a net loss for a few years, as compared with the cost of barging coal with a diesel-powered ship, says James Monk, manager of fuel supply development for the utility. But he calculates that a net savings will occur in 1989 ($9.13 per ton on the CV-2000 versus $9.27 per ton barged), owing largely to intrinsic savings on increasingly costly oil and increasing net profitability thereafter.

What about all the ash from the propulsion system? If ash from the ship's combustor accumulates on the ocean bottom over which CV-2000 travels during her entire 24-year amortized lifetime, it would form a layer only 0.004 inch thick, says Mr. Monk.—*L.A.P.* ☐



1 Ship's fuel bunkers
2 Discharge chute - boom
3 Boom conveyor
4 Boom hoist cylinder
5 Ballast and cargo control room
6 "A" frame
7 Discharge chute - lift conveyor
8 Lift conveyor
9 Hatch cover
10 Cross conveyor
11 Cross conveyor
12 Lift conveyor
13 Hold conveyor
14 Cargo
15 Hold conveyor

Artist's conception of the CV-2000, the first coal-burning ship to be built in the United States since the end of World War II. The automatic unloading system detailed in the drawing can unload a 36,000-ton coal shipment at the rate of 3,600 tons per hour. The boom conveyer (3) is 260 feet long. (*Drawing: New England Electric System*)

gest using a system (called LASH, for "laser-ash") containing an array of ten 0.33-kilojoule CO_2 gas lasers, which they estimate would cost about $1.5 million. They calculate that such a power plant would save $50 million of fuel costs in a 20,000-deadweight-ton cargo ship, and nearly $200 million in a large 250,000-ton merchant tanker over a ten-year period.

A new concern has emerged since coal was last in vogue on the high seas: the environmental effects of its combustion. For every hour at sea, a 5,000-horsepower coal-fired power plant produces 55 pounds of particulate emissions, and, at least when the ship is operating near shore, these might have to be collected and retained for later disposal. In general, ash cannot be dumped within countries' territorial limits, so coal-fired ships will have to be prepared to store the ashes from several days' operations in port so that they can be dumped at sea. The New England Electric System demonstration vessel now under construction solves these problems by carrying both coal and oil, the latter for use when entering and leaving port. However, this solution would probably not be economical for transocean carriers.—*J.M.* □

DENNIS MOORE

Managing

Penny Wise

To save millions of dollars yearly, the U.S. Treasury Department is overhauling the penny—and you probably won't know the difference.

The new penny, which should be in circulation early this year, is made of a zinc-alloy core plated with copper. It will contain 97.6 percent zinc and 2.4 percent copper overall; the old coin was 95 percent copper and 5 percent zinc. No new technology is required to strike the coin, which looks just like the old model and wears as well. (To test their durability, new coins were tumbled in a simulated "pocket," a container lined with moistened cotton twill, for 600 hours.)

The reason for the switch: skyrocketing copper prices. When copper metal costs $1.12 per pound, the total cost of producing a penny is more than a cent. And when copper hits $1.50 per pound, the metal's intrinsic value alone exceeds the coin's face value. The price of copper rose from $.93 to $1.45 per pound from December 1979 to February 1980; subsequently it has fallen as low as $.80 per pound, but industrial demand for the metal remains strong, promising future price hikes.

Zinc has been 20 to 50 percent cheaper than copper over the past 20 years, and the Treasury stands to save $25 million a year by going to the new penny, estimates U.S. Treasurer Angela M. Buchanan. The new penny is also expected to improve our balance of trade—by $34 million annually. "Even if all the zinc necessary to meet the increased demand had to be imported," says the Congressional Research Service, the costs would be more than offset by the savings from decreased copper imports.

A process called barrel electroplating, long used in the manufacture of jewelry, electrical components, and machine parts, is used to make the blanks for the new penny. Zinc-alloy "cores" are tumbled in a rotating barrel containing a copper cyanide electrolyte solution. Copper builds up on the blanks and is allowed to become at least 0.0002 inches thick. Because copper cyanide is highly toxic, all phases of the process are subject to controls set by the Environmental Protection Agency.

The new pennies weigh 19 percent less than the old ones, and this difference will initially inconvenience banks and retail stores that count them by weight. However, they should work as well as ever in vending machines and other coin-handling equipment, according to the National Automatic Merchandising Association.

Hoarders, take note: this year nearly 21 million pounds of the new pennies—some 3.6 billion of them—will be minted, representing about one-third of total penny production. A mix of old and new will continue for two years, when no more of the old pennies will be made. Says Ms. Buchanan: "By producing one-cent coins of both materials with the same date, we will help curtail the speculative withdrawal of the old penny from circulation."—*T.B.* □

No Room in the Backyard: Sites and Sounds for Hazardous Waste

"Today we begin a new era in the safe management of hazardous wastes," declared Governor Edmund G. Brown, Jr. of California last October 13. He had just signed an executive order to "reduce our dependence on chemical landfills . . . and to encourage the construction of facilities for the recycling, treatment, and permanent destruction of toxic wastes."

Relying heavily on recommendations by his Office of Appropriate Technology, Governor Brown estimates that new waste-treatment facilities based on "feasible, affordable, and safe" technologies will be able to handle 75 percent of California's hazardous wastes, which would otherwise be buried in landfills. The governor also banned six classes of "high-priority" wastes (PCBs, pesticides, toxic metals, cyanides, halogenated organics, and nonhalogenated volatile organics) from land disposal by January 1983, and announced economic incentives and regulatory streamlining designed to encourage private treatment facilities.

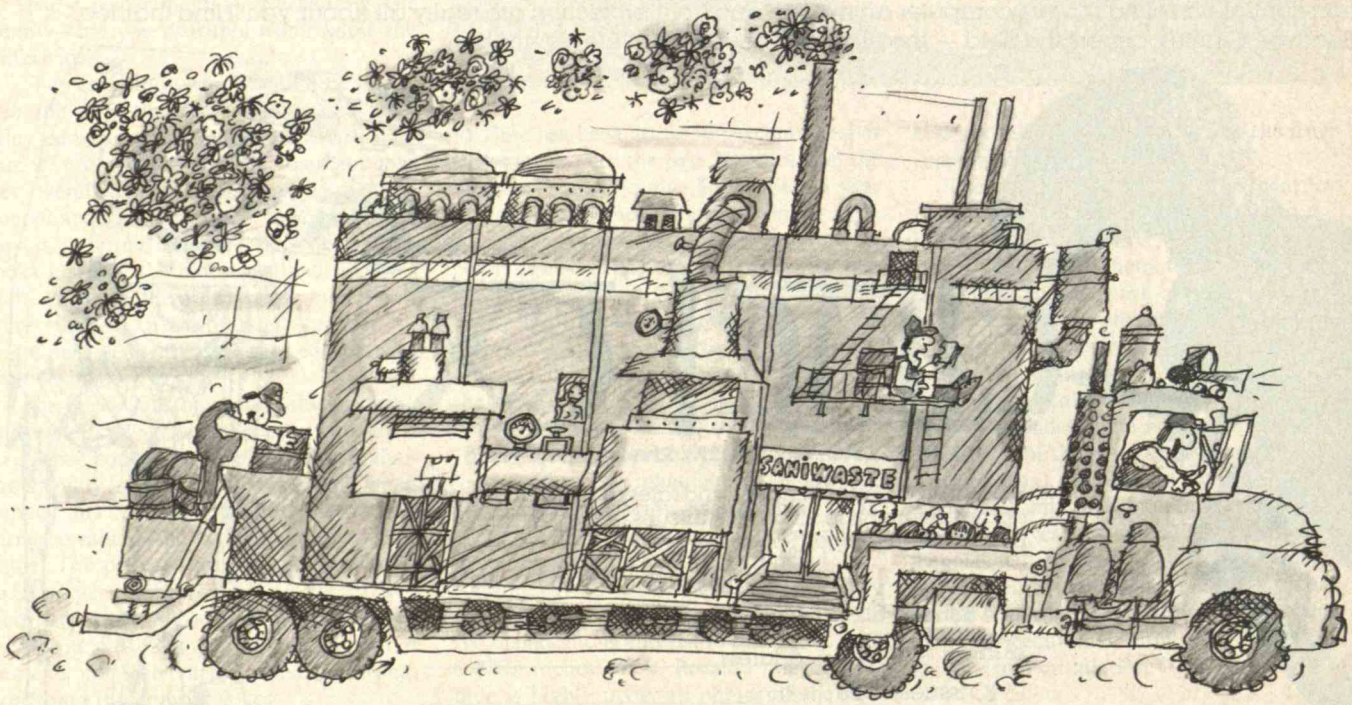
Governor Brown was justifiably proud of his new policy that aims to avoid the thorny political problem of siting hazardous-waste dumps—75 percent of the time, anyway—by eliminating them. But meanwhile, back at the other coast, public opinion is making it clear that communities don't much want hazardous-waste *treatment* facilities in their backyards either.

Westford, Mass. said "no" (on October 16) and then Warren, Mass. said "no" (on November 21) to a hazardous-waste treatment plant proposed by the IT Corp. The plant would incinerate, neutralize, detoxify, and recycle up to 500,000 tons of hazardous wastes per year. Massachusetts itself currently produces about 300,000 tons—of which about 10 percent is treated in the state (the rest is shipped out or illegally dumped)—so that the facility's "host community" could well become the hazardous-waste capital of New England.

The Westford and Warren cases represent more than just another instance of the not-in-my-backyard mentality. The towns attempted to reaffirm "home rule," an old New England tradition, whereby the community decides, without outside interference, what is good for itself. A new state law, the Hazardous-Waste Facility Siting Act, can suppress home rule by limiting community options on a site that has been approved by the state. According to James Coleman, director of the (hazardous-waste) Regulatory Task Force within the Massachusetts Department of Environmental Quality Engineering, "A developer proposes a site [available for purchase], and if the state labels it feasible and deserving, the community must negotiate with the developer. The community simply can't say 'we don't want it.' "

But communities appear to be circling their wagons and challenging state-imposed projects for the common good. Events similar to those in Massachusetts have been unfolding in Tennessee, for example, and New Jersey's new siting law may be headed for local showdowns.

Many might regard such opposition as "emotional" impediments to progress. Indeed, while a *Boston Globe* editorial last year hailed the state's new (still formally unchallenged) hazardous-waste siting law, it also warned against undue public resistance. "Solutions are possible," said the *Globe*, "but only when the public is ready to accept them." A reasonable addendum might be: public acceptance is possible, but only when the community's trust is earned. In this view, the burden of proof is on the developer, or the state, or any other group that is pressing a community to accept a potentially hazardous facility. After the safety of a process is adequately demonstrated, safeguards against accidents are shown to be sound, and benefits to the community expressed in concrete terms and deemed to be sufficient—perhaps then will it be realistic to expect "public acceptance."—*S.J.M.* □



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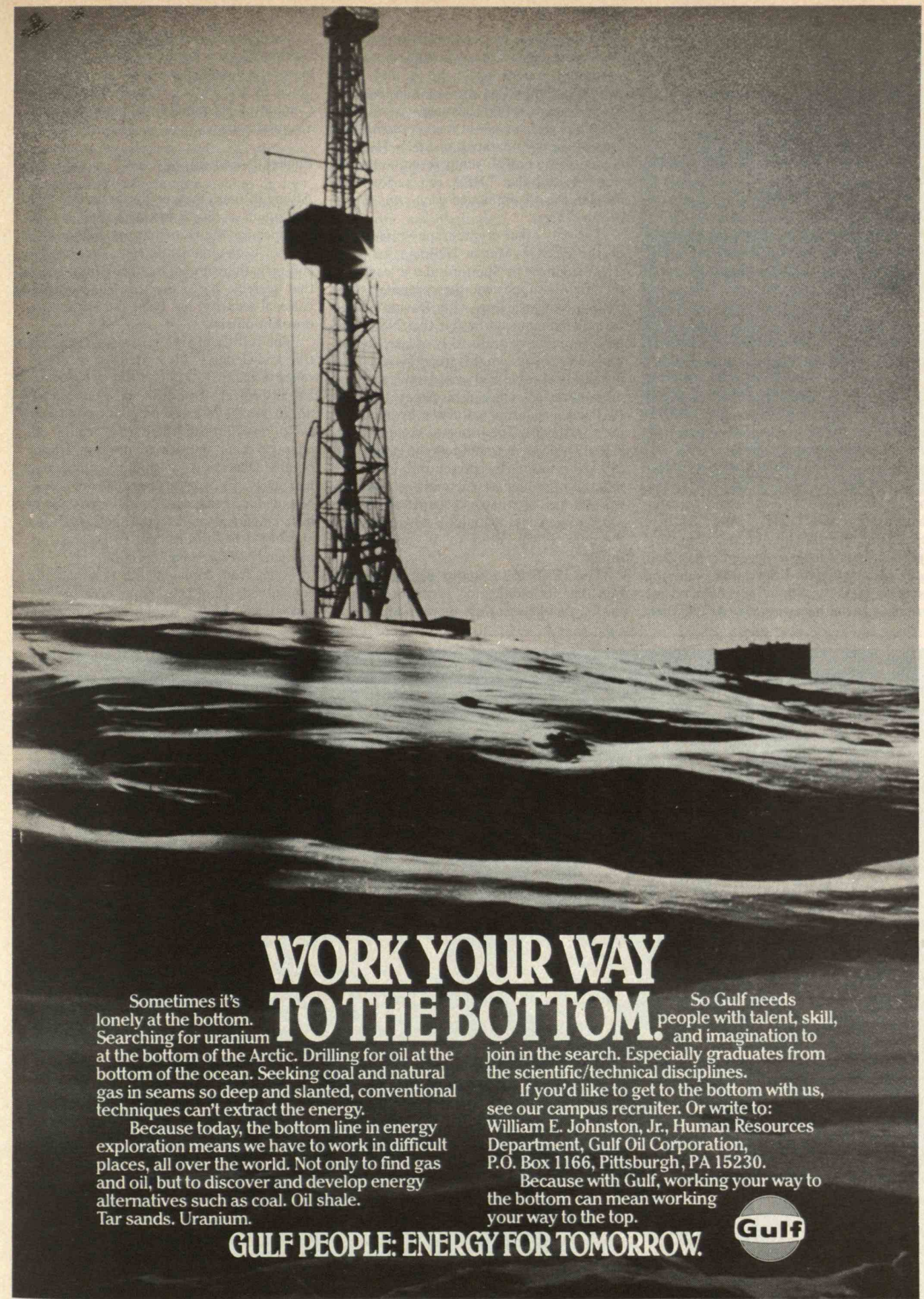

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Unger/Continued from page 39

ics, engineering, computer science or statistics, and basic theoretical research." Manuscripts would be returned promptly to the authors with explanations "to the extent feasible of proposed changes, deletions, or delays in publication, if any." A disagreeing author could request a review by a standing advisory committee, with two members appointed by the NSA director and three by the president's science advisor. The entire process would be voluntary, with neither authors nor publishers required to participate or comply with any proposed restrictions.

This proposal was accepted by all members of the PCSG except George Davida (nominee of the IEEE Computer Society), who wrote a minority report arguing against any restraints. Among his many objections is the difficulty of distinguishing between basic research and knowledge directly applicable to actual systems. As an example, he points out that one new encryption scheme, already used in a safeguard system at a nuclear power facility, depends on the difficulty of factoring very large numbers. However, progress has been made recently toward developing efficient factoring methods. Should this field, one of the oldest in mathematics, now be regarded as falling within the regulated category?

Davida also expressed concern that a voluntary system could be a first step toward a compulsory system, and that the PCSG report could be used to validate NSA's argument about the necessity for controlling cryptography research. He concluded that control would serve no useful purpose, and that "NSA can perform its mission the old-fashioned way: *stay ahead of the others.*"

The only other cryptography researcher on the PCSG—Martin Hellman, an electrical engineer at Stanford and a leader in the field—supported the proposal. Although sympathizing with Davida's concerns, Hellman said he felt that NSA had been acting more reasonably of late, and he wished to encourage this trend by responding positively. He had even begun sending prepublication copies of his papers to NSA (without promising to abide by requests not to publish). The thrust of his argument is that the system would test the validity of NSA's position by presenting its arguments to the advisory committee. And he worried that if what he regards as NSA's more reasonable attitude is not rewarded, the agency will revert to its earlier position.

The IEEE has recently taken the position that its publication procedures place the burden of securing appropriate industrial and governmental clearances on the authors; hence it is unlikely to involve itself directly in the voluntary review system proposed by the PCSG. The Association for Computing Machinery will probably adopt a similar stance.

Enough Is Enough

Although there may be disagreement over how much secrecy is justified, there is little evidence for the view that the government has not been sufficiently secretive. On the contrary, there are all too many indications that secrecy, particularly in the name of national security, has been abused by government officials.

The futility of trying to suppress scientific knowledge is illustrated by an occurrence in the early 1940s. Prior to the Manhattan project, American scientists agreed not to publish research on nuclear fission to avoid revealing anything that would encourage other nations to develop atomic bombs. Observing this sudden publication halt, G.N. Flyorov, a young Soviet physicist, deduced that the United States must have embarked on a secret nuclear project and urged his government to proceed immediately in the same direction.

Apart from damaging our technological competence, prior censorship, even in a few specialized fields, would set dangerous

precedents. Freedom of speech and freedom of the press are too precious to be jeopardized by what can only be described as loss of nerve.

Censorship should not be encouraged in any way. Even such an apparently innocuous voluntary system as the PCSG proposal is dangerous, establishing censorship machinery and accustoming people to its very existence. This makes the next step easier: compulsory review. The threat of expanding government secrecy in technology merits the serious attention of scientists and engineers—both as professionals and as citizens—and should be strongly resisted.

Further Reading

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Stephen H. Unger earned a Ph.D. in electrical engineering at M.I.T. and is currently a professor of computer science at Columbia University. His book, *Controlling Technology: Ethics and the Responsible Engineer*, will be published this spring (Holt, Rinehart, and Winston). This article is adapted from a paper prepared for the Committee on Scientific Freedom and Responsibility of the American Association for the Advancement of Science.

Letters/continued from p. 4

tists who will move this society into a "golden age" of advancement.
Ken McGhee
Washington, D.C.

Samuel Florman asserts that we have the freedom to run technology rather than be run by it. Yet he concludes by saying, "For all our apprehensions, we have no choice but to press ahead . . . We simply cannot stop while there are masses to feed and diseases to conquer, seas to explore and heavens to survey." If we cannot stop, then we have no freedom. Perhaps Mr. Florman is only being rhetorical; being tragic often means being blind.
David Lukens
Evanston, Ill.

It is astounding that Samuel Florman fails to examine the public institutions that generate new technologies and thereby shape their character. Lofty speculations by Shakespeare, Hegel, and George Steiner offer little insight into why people fear technology. There are structural and institutional reasons why Ford Pintos are dangerous in rear-end crashes and why job automation can make work less enjoyable and even oppressive. Coaxing the scaredy cats who worry about "out-of-control" technology out of their "immaturity" will take more than platitudes.
David Bollier
Washington, D.C.

Mr. Florman responds:
Dismay over public institutions is an appropriate companion to fear of technology. In blaming amorphous evil forces, Mr. Bollier avoids confronting real problems to which there are no easy answers. People want cars that are cheap, snappy-looking, and fuel-efficient; they want to enjoy the wondrous benefits of electronic technologies and use the splendid products that flow from automated factories. But people must face up to the consequences (not all pleasant) of their desires. Refusal to do so is not political sophistication it is, indeed, immaturity.

Not Needs but Desires

John Mattill states in his "Engineering the Ivory Tower" (*October, page 2*) that "by definition engineering is science applied to the needs of humanity." This is the conventional definition of engineering, but not the definition of engineering as it really is.

Engineering is not limited to applied sciences; it includes the great body of information obtained by testing and experience. A good definition of engineering is "the use of forces and materials of nature to satisfy the desires of humanity." Young engineers who believe that science is the sole source of their knowledge are in for a rude awakening. Certainly the fraction of engineering knowledge common to science is steadily increasing, but it is still much less than 100 percent.
William M. Brobeck
Berkeley, Calif.

Cottage Computer Industry

After reading Alvin Toffler's *The Third Wave*, I was very interested in Robert Cowen's comments in "Cottage Computing: Glorifying the Trivial" (*November/December, page 6*). Mr. Toffler points out the schism between home life and business life in industrial civilizations. Other commentators have noted that the determined exclusion of children and adolescents from business life has alienated one generation from the next. I take exception to Mr. Cowen's view. The microcomputer is a viable alternative to the large-scale disruption of family life caused by centralized processing facilities.
John T. Wilson
Somerville, Mass.

Why is it foolish to use a computer to do things we already do with less expense and effort? I'm not a computer nut, but I appreciate its application in my home and business. My Apple provides me with cash-flow information, investment analysis, budgets, and other business tasks in about one-fifth the time it takes my company computer to perform these functions. I don't know much about programming but I'm learning, and what is more important, my children are learning too.
Thomas N. Hearn
Minneapolis, Minn.

Solution to the CO2 Problem

L.B. Lave's "A More Feasible Social Response" *(November/December, page 22)* seems unduly pessimistic about government initiative in dealing with atmospheric CO2 buildup. A proper strategy would be to eschew price controls, allow fossil fuel to be priced by the market, and prevent externalization of costs by users through rigorous environmental-protection regulations such as smog control. Penalties on fossil-fuel use will make alternative energy sources economically attractive sooner.
Kenneth Turner
Sacramento, Calif.

M.I.T. REPORTER

Dieting with Suppressants

Overweight people who succumb to the temptations of carbohydrate-rich foods may be lacking in more than will power: their natural systems for regulating carbohydrate intake may be faulty.

Several years ago Drs. Richard and Judith Wurtman of M.I.T. proposed that a brain neurotransmitter called serotonin was involved in a kind of inverse feedback loop to control human carbohydrate consumption. Their theory was that carbohydrates stimulate serotonin secretion, and the serotonin itself then acts to suppress the craving for more carbohydrates. Now, to extend that theory, they tested serotonin stimulants on a number of obese subjects and find that the subjects' craving for carbohydrates—especially at afternoon and evening snack times—is sharply reduced.

The Wurtmans' result suggests that drugs that decrease cravings for certain foods may be useful weight-reduction strategies. And it calls into question the wisdom of weight-loss diets that are high in protein, Dr. Judith Wurtman told the *New York Times*: high-protein diets may actually increase cravings for carbohydrates, "dooming the dieter to periodic calorie-laden carbohydrate binges." □

Images of the Ballet

An "interactive theater set" that "dances with the dancers" is now being developed by two M.I.T. graduate students working with the Joffrey Ballet Company. According to Ann Marion and Scott Fisher, graduate students in visual studies, advanced methods of computer body-tracking and imaging—borrowed from biomedical engineering, kinesthesiology, and flight simulation—will permit dancers to create images on a screen by their movements and gestures. The audience, says Ms. Marion, will gain "new impressions of physical motion, . . . making unseen processes visible."

At the same time, the system will record the three-dimensional spatial relationships of a dance which can be stored in a computer and later retrieved for "stereo" viewing on a screen from *any* point of view. □

Catalysts for Olefins

The discovery of new catalysts that make it easier to modify olefins and acetylenes has been reported by Richard R. Shrock, professor of chemistry. He believes the new materials may for the first time make possible systematic control of these hydrocarbon materials, important in the production of fuels, synthetic fibers, detergents, plastics, and other products.

The new catalysts are based on compounds of tungsten; they capitalize on the unusual ability of tungsten to establish multiple bonds with carbon atoms. The result is a metathesis reaction, previously unknown in acetylenic compounds. □

Florman/continued from p. 13

did not support the concept of centralized control over regulatory agency procedures. Then representatives from OSHA, EPA, FDA, and the Consumer Product Safety Commission presented variations on a general theme—agreeing that no standardized formula could be used to judge such complex problems.

Joseph V. Rodricks, a distinguished chemist at FDA, observed that the proposed legislation did not take into account the differences among the legislative acts under which Congress established the regulatory agencies, or the different mandates that make a standardized procedure unwise, even within each agency. For example, the FDA regulates food additives, food contaminants, and drugs according to three completely different standards.

Food additives must be absolutely safe, he said, and the burden of proof rests with each additive's sponsor. For food contaminants, the government must prove hazard to health, and acceptable levels must often be established using distressingly meager information. For drugs, the balance of risks and benefits presents an entirely different sort of problem. Congressional statutes are full of such terms as "generally recognized as safe," "reasonable certainty," "unreasonable risk," and "reasonable, technologically practicable, and appropriate"—terms that differ subtly but substantially and do not lend themselves to a unified mathematical standard.

(On June 17, 1981, the Supreme Court ruled that in promulgating cotton-dust safety standards, OSHA was not required to demonstrate a reasonable relationship between costs and benefits, since Congress had mandated a standard that would protect health "to the extent feasible.")

If Rep. Ritter found such opposition at all convincing, he gave no indication. "I would just like to say," he concluded, "that Congress and the American people are beginning to rebel against what they perceive to be an overly bureaucratic, dogmatic, and perhaps dictatorial regulatory apparatus."

Although the hearing ended with expressions of thanks and mutual admiration, it was clear that the proposed legislation had provided a battleground for bitterly antagonistic forces.

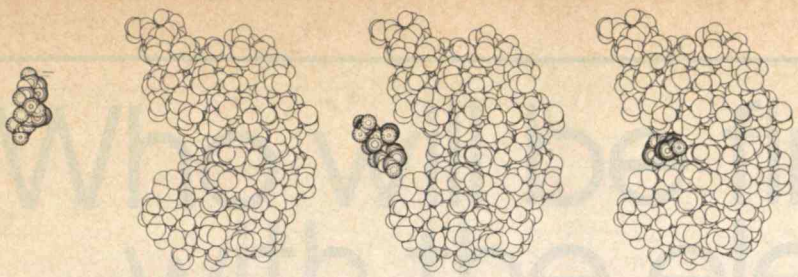
Take-Home Lessons

Although I approached the subject of risk assessment with high hopes and a disposition to be persuaded, I could only conclude that Rep. Ritter's attempt to apply mathematical consistency to the regulatory process has been deplorably simplistic. Worse, it has provided an opportunity for the industrial enemies of regulation to take "rationality" as their rallying cry, giving force to the longstanding charge that engineers are flunkies for the corporate establishment.

Much is yet to be heard about risk assessment. The newly formed Society for Risk Analysis has begun a journal called *Risk Analysis*. The National Academy of Sciences, at the behest of the National Science Foundation, has established a Committee on Risk and Decision Making. The American Association for the Advancement of Science's "Five-Year Outlook Project" contains a risk-assessment section prepared by William W. Lowrance of Rockefeller University. He sees a pressing need to educate the public about the nature of risk, but warns against the simplistic use of a technology that is still in its infancy.

Clearly the public's perception of risk deserves attention. However, it is equally clear that risk assessment is a delicate tool that needs to be applied sparingly, not a machete to be flailed against the overgrown regulatory jungle.

Of course, regulators need to be regulated. Each regulatory agency is properly



Computer programs now allow chemists to view a molecule from any angle. But new software by Professor Gregory A. Petsko and Dr. William A. Gilbert at M.I.T. adds new dimensions—for example, how its structure permits a substrate (left) to dock into the active site of an enzyme to powerfully catalyze a chemical reaction in the digestive process.

The Year of the Robot

In the M.I.T. Artificial Intelligence Laboratory, this is officially the Year of the Robot—the beginning of a period when "we are going to try to make a quantum jump in robotics," says John Hollerbach, research scientist in the AI Laboratory's robotics section.

The problem, says Dr. Hollerbach, is one of achieving a "critical mass" of robotics research. Joint funding from the Office of Naval Research and the Defense Advanced Research Projects Agency will help bring more robotics experts to Cambridge, as well as cover new seminars, courses, and books and the introduction of the *International Journal of Robotics Research* to gather into one periodical papers now dispersed in many journals.

For the intermediate term, the program's two main goals will be:

☐ Design and control of a multi-finger hand with sensory capabilities, on which work has already begun.

☐ Design of a task-level computer language. With such a language, for example, one would simply instruct a robot to "pick up the cup" without directing it through all the point-to-point steps that make up the task.

One feature of a recent two-day workshop on the development of dexterous robot hands was a report by William D. Hillis, an M.I.T. graduate student in electrical engineering and computer science, on an experimental robot finger with a touch sensor at the tip, an array of 256 tactile sensors comparable in size and resolution to the tip of the human forefinger. It has a skin-like texture and is flexible and rugged.

The tactile recognition computer program that operates the finger is "knowledge-driven"—that is, Mr. Hillis says, the program must have some expectation or hypothesis of what it is feeling. "It recognizes the object by actively probing it with the finger, modifying its internal "hallucination' of the object to conform with the measured reality."

By this process, the finger can recognize a set of common mechanical fasteners—machine screws, flat washers, lock washers, dowel pins, and cotter pins—objects which "are important for potential industrial applications of robotics," says Mr. Hillis.

The next goal is the design of a more sophisticated three-finger hand with one opposing digit, which will likely involve materials and mechanics that closely mimic the tendon-in-sheath structure of the human hand, according to Dr. Hollerbach. Also possible, in Mr. Hillis' opinion, are fingers capable of texture recognition, perhaps by means of embedded piezoelectric devices, that can tell the difference between paper and glass, for example. In addition, he has already experimented with a temperature sensor for a robot finger.—*William T. Struble* ☐

constrained by statute, continuing legislative oversight and judicial review, and political realities as perceived by canny agency bureaucrats. Rep. Ritter has done his profession a disservice by suggesting that all regulatory decisions would benefit from being filtered through identical mathematical sieves.

On September 24, 1981 at a brief hearing before the same subcommittee, the Ritter legislation suffered a serious rebuff. James C. Miller III, chairman of the Federal Trade Commission and former director of the Presidential Task Force on Regulatory Relief, announced that, in view of other antiregulatory actions already being taken, the Reagan administration considered the bill "basically redundant." This probably signals defeat for the bill, although not for the ideas behind it. The battle against the misuse of risk analysis has yet to be fought.

Just as self-knowledge is the beginning of wisdom, so is the essence of rationality a recognition of its proper limits. ☐

Samuel C. Florman is vice-president of Kreisler Borg Florman Construction Co. in Scarsdale, N.Y. His most recent book is Blaming Technology: The Irrational Search for Scapegoats *(St. Martin's Press, 1981).*

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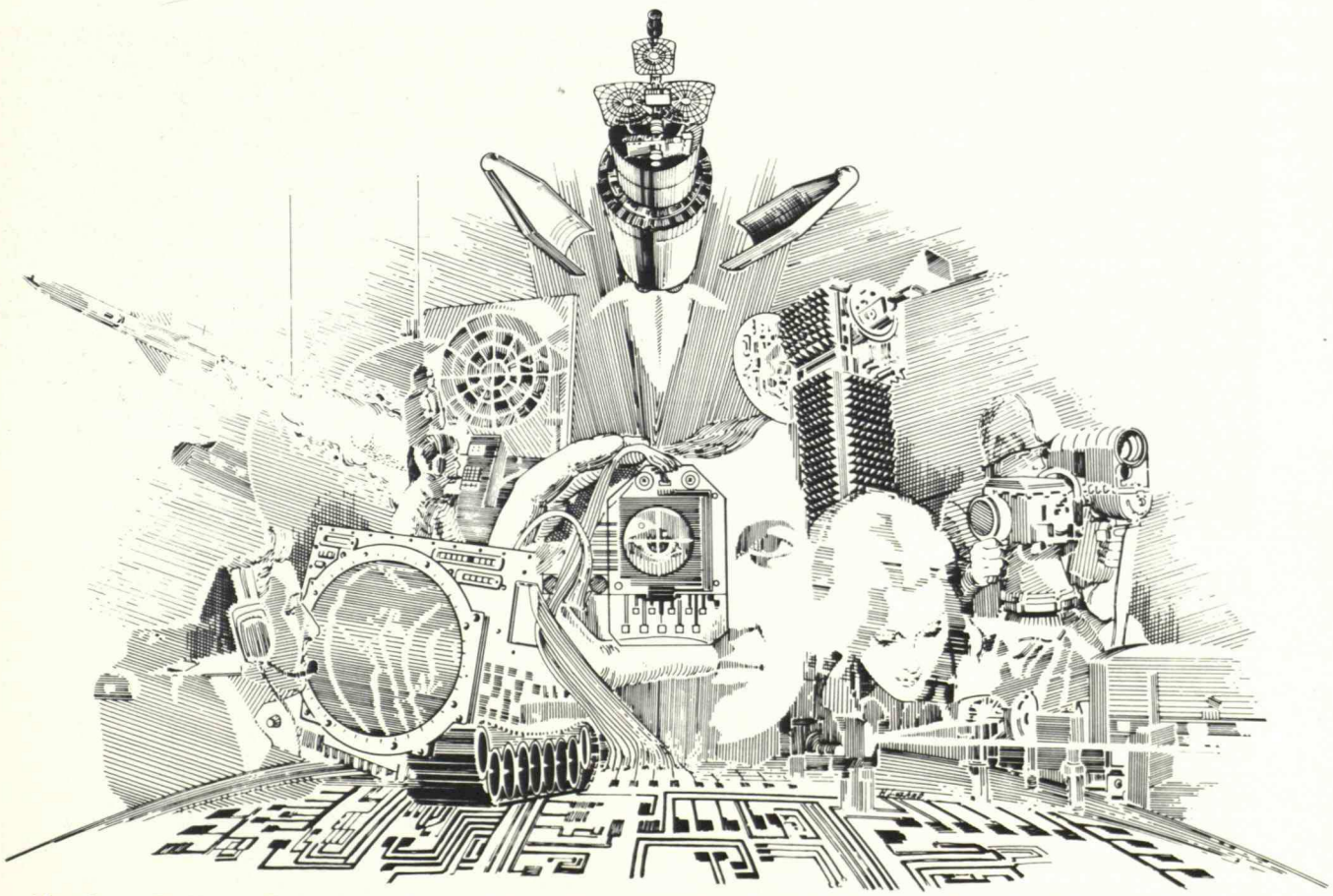

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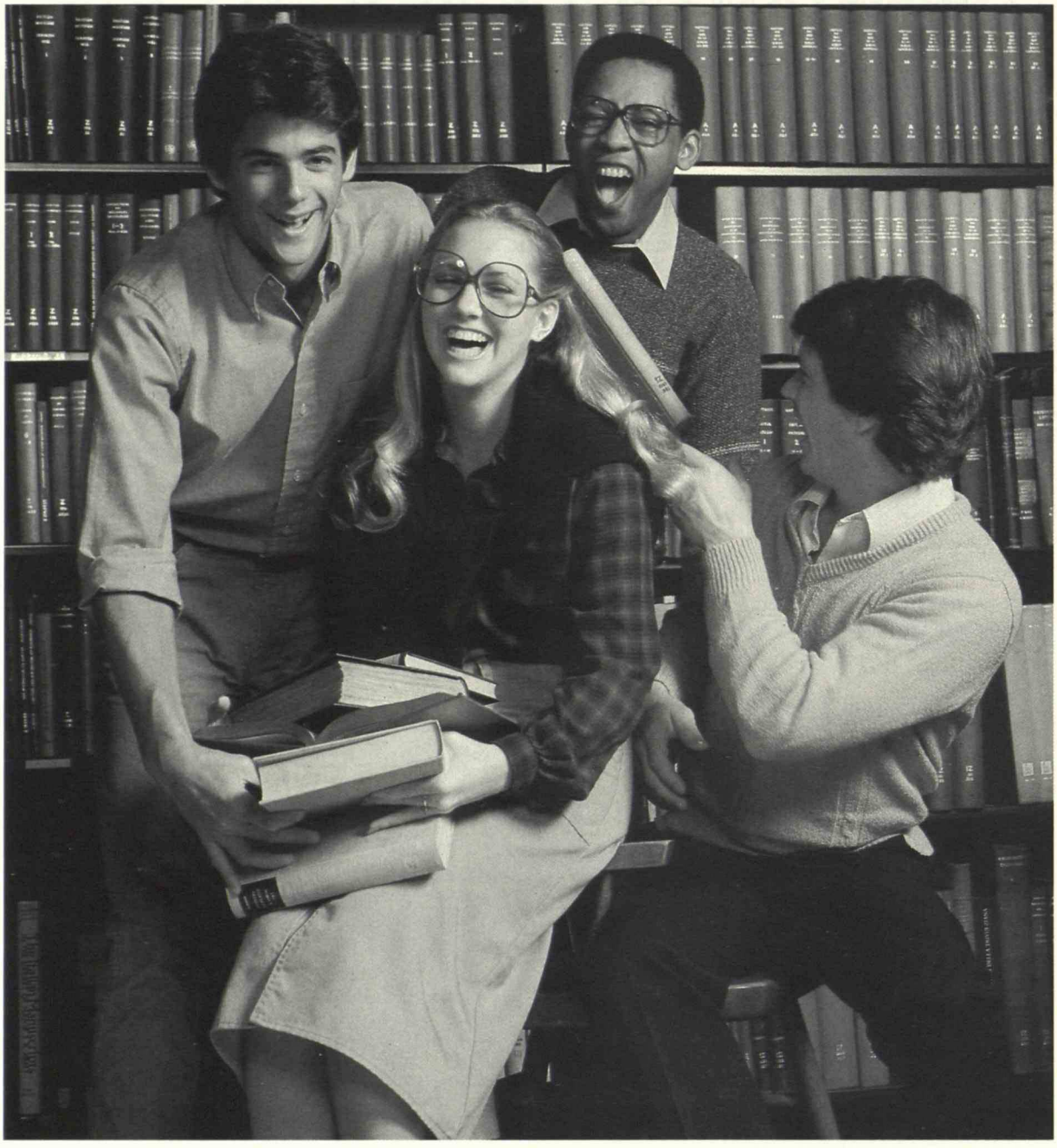

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Ronald Haynes BS, Chemical Engineering

"I'm an instrument engineer with the Design Division of the Engineering Department at Du Pont, involved in designing process instrumentation from design to specification writing to working with vendors. This job offers me plenty of technical challenge. That's what I wanted when I came to Du Pont.

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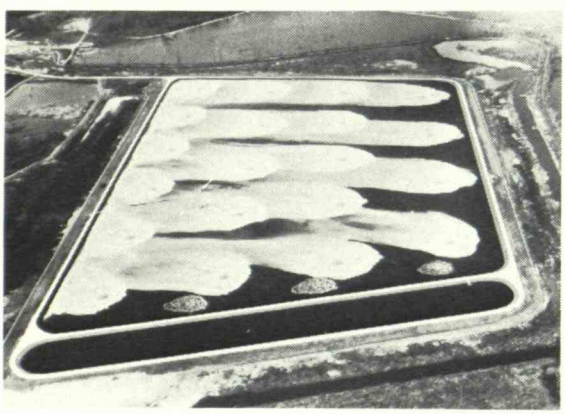

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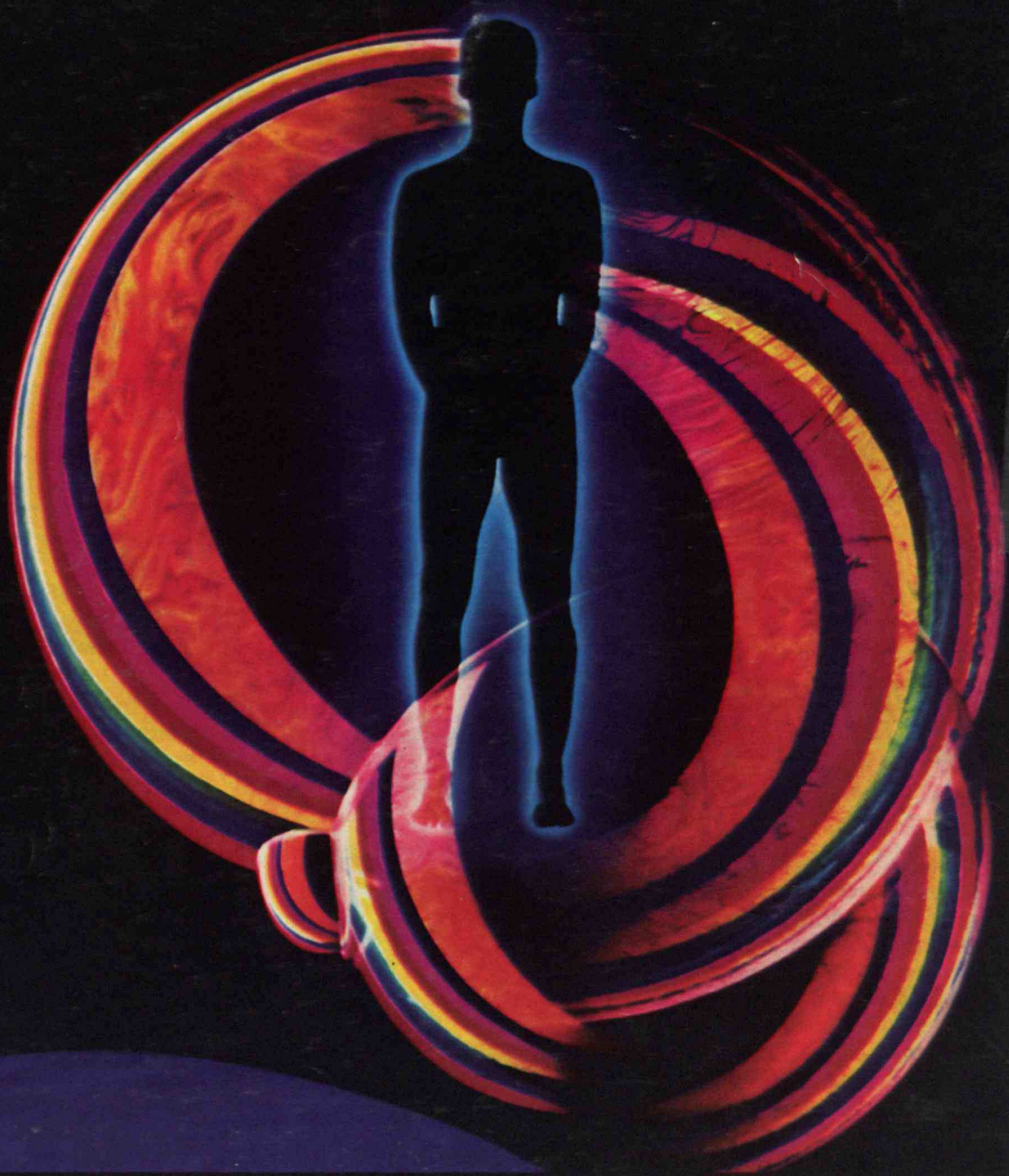

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